

May 11, 2001

**TOOELE ARMY DEPOT
INDEPENDENT TECHNICAL REVIEW**

**FINAL RECOMMENDATIONS
REPORT**

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ACRONYMS AND ABBREVIATIONS

ACL	alternative concentration limits
ALCD	Alternative Landfill Cover Demonstration
bgs	below ground surface
BRAC	Base Realignment and Closure
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
CT	central tendency
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DSHW	Division of Solid and Hazardous Waste (of UDEQ)
DQO	data quality objective
EDMS	environmental data management system
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FUDS	Formerly Used Defense Sites
GMS	Groundwater Modeling System
HEC	Hydrologic Engineering Center
HI	hazard index
ITR	Independent Technical Review
IWL	Industrial Wastewater Lagoon
MACOM	Major Army Command
MCL	maximum contaminant level
MNA	monitored natural attenuation
MSC	Major Subordinate Command
NA	no action
NPL	National Priorities List
POC	point of compliance
POE	point of exposure
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetrinitramine
RFI	RCRA Facility Investigation
RG	remedial goal
RME	reasonable maximum exposure
ROM	Restoration Oversight Manager
SVE	soil vapor extraction
SWMU	solid waste management units
SWMU 2	IWL and Ditches
SWMU 10	Washout Facility
SWMU 12/15	North Area Sanitary Landfill
SWMU 58	Industrial Area Groundwater Sources
TCE	trichloroethylene
TEAD	Tooele Army Depot

TNT	trinitrotoluene
UCL	upper concentration limit
UDEQ	Utah Department of Environmental Quality
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USGS	United States Geological Survey
VOC	volatile organic compound
WES	Waterways Experiment Station (U.S. Army Engineer Research and Development Center)

**Tooele Army Depot
Independent Technical Review**

FINAL RECOMMENDATIONS REPORT

EXECUTIVE SUMMARY

This report presents the findings and recommendations of the Independent Technical Review Team (ITR team) regarding remediation activities at selected Tooele Army Depot (TEAD) Solid Waste Management Units (SWMU), specifically, the Trinitrotoluene (TNT) Washout Facility (SWMU 10), North Area Sanitary Landfill (SWMU 12/15), Industrial Wastewater Lagoon (IWL) and Ditches (SWMU 2), and the Industrial Area Groundwater Sources (SWMU 58). Primary objectives of the ITR team include:

- Promoting the use of risk-based approaches as remediation decision-making tools
- Promoting risk management approaches to ensure that the costs and benefits of remedial alternatives are properly assessed and balanced
- Identifying opportunities to streamline the remediation process
- Providing expert technical assistance to the Installation.

Based on the review, the ITR team concluded that:

1. A site-wide strategic plan with a conceptual model should be prepared for TEAD to coordinate remedial operations, promote proactive rather than reactive activities, and allow for prioritization of the cleanup effort.
2. Site data should be compiled into a single electronic environmental data management system (EDMS) database. The EDMS should be managed by a single entity but available to all contractors that work at the facility.
3. The modeling studies at TEAD should be consolidated into one activity and should be conducted using the Department of Defense Groundwater Modeling System (GMS).
4. The distinction between risk-based or legal drivers versus judgment and preference should be established for each SWMU. Specific drivers should be identified for any action taken at the facility.
5. Risk-based decision-making should utilize the most recent risk assessment guidance including the use of statistical concepts (e.g., domain averaging)

6. Army policy requires that all decision documents include an evaluation of no further action and monitored natural attenuation as optional remedial courses of action for a SWMU.

The ITR team has also developed the following recommendations to enhance the existing remediation program at TEAD, and help ensure the selection of cost-effective and protective response actions at each SWMU:

The TNT Washout Facility (SWMU 10) activities should be based on more accurate exposure domain concentrations and site-specific risk parameters and evaluation of corrective action alternatives that satisfy all legal requirements and Army policy.

The existing data and attendant analysis does not support implementation of a \$5 million corrective action. Remediation requirements must be based on realistic exposure domain concentrations and site specific exposure pathways. Risk-based corrective measures, including the no action, monitored natural attenuation (MNA), contaminant isolation, hot spot management, or “clean closure” scenarios, must be evaluated in accordance with legal requirements and Army policy. In addition, the classification of material that may be excavated should be revisited. The option of land filling a reduced volume of excavated material off-site in a hazardous waste landfill, as a non-hazardous waste may be a cost effective, legal option.

North Area Sanitary Landfill corrective action should be conducted only to the extent it demonstrably improves off-site groundwater quality. The available data demonstrates that groundwater quality downgradient from the landfill is improving under current conditions. This indicates that the rate at which contaminants may be reaching the groundwater from the landfill is less than the attenuation rate of those contaminants once they reach the groundwater. The data also indicates that downgradient contamination may not even be related to the landfill. Although soil gas contamination has been measured within the landfill, there is currently no evidence that corrective action in the landfill will benefit off-site groundwater restoration. The ITR team recommends the following specific actions for the North Area Sanitary Landfill:

1. Establish a landfill-specific groundwater-monitoring plan that contains quantitative criteria upon which the necessity for corrective action is based. The criteria should be based on the EPA Presumptive Response Strategy. Action should be implemented only if necessary to prevent plume expansion and/or prevent risk pathways from being completed. The monitoring plan should utilize the existing monitoring network with minor modifications,
2. Install a groundwater monitoring well near the Seamist vadose zone sampling location to estimate the ongoing contribution (if any) of vadose zone contamination to groundwater plume expansion beyond the landfill,
3. Utilize geostatistical methods to evaluate the adequacy of the spatial distribution of soil gas sampling location at the landfill, and

4. Regrade and cover select areas of the landfill to ensure that solid waste is not exposed at the ground surface.

The North Area Sanitary Landfill is a SWMU in accordance with the Utah Department of Environmental Quality (UDEQ) Division of Solid and Hazardous Waste (DSHW) rules. The ITR team believes that TEAD should pursue a risk-based closure.

TEAD should modify compliance boundaries and establish source area performance standards that maintain a maximum contaminant level (MCL) at the property boundary. The ITR team recommends that groundwater be managed with performance standards that vary with distance from the TEAD property boundary. Performance standards would be concentrations at the edge of source areas that maintain an MCL at the point of exposure (i.e., receptors at or near the TEAD property boundary). The performance standard may be a combination of vadose zone or groundwater criteria that results in a flux out of the source area that is protective of the property boundary MCL.

TEAD should develop a site-wide monitoring plan that is consistent with and addresses critical uncertainties identified within the framework of a holistic strategic plan. The ITR team recommends the site-wide monitoring plan should be examined in light of a strategic plan to identify the appropriate data and frequency for dealing with the critical uncertainties identified at a given source area or SWMU.

The Hydrologic Engineering Center (HEC) groundwater model should be utilized to evaluate flow characteristics on the eastside of the bedrock area and study dissipation of the groundwater mound under the IWL. The HEC groundwater model should be used to:

1. Provide a vector analysis of flow around the east side of the bedrock structure,
2. Look at the apparent discrepancy between water quality and flow paths of the main and northeast boundary plumes,
3. Study the dissipation of the groundwater mound that existed under the IWL, and
4. Estimate the dilution and attenuation factor that may be applied to the plume at various distances from the property boundary.

Staged modification of the extraction system should be considered to evaluate alternate operations designed to improve remedial activities at TEAD. The staged modification of the extraction system should be used to determine the effectiveness of different extraction well configurations and source control strategies in satisfying an MCL concentration at the property boundary. Modification decisions need to be based on modeling the existing system with the following specific issues in mind:

1. The effects of pulse and surge pumping on the boundary conditions and acceleration of plume restoration,
2. The relative impact of vadose zone vs. groundwater sources on plume persistence and boundary conditions, and
3. The likely relative value of source treatment (vadose zone or groundwater) compared against source management.

Pilot testing to address source removal should be designed to address the value (relative to groundwater restoration) of elimination of contaminants in the vadose and/or saturated zone within one or both of two types of source conditions. The planned pilot testing is currently limited to SVE. Furthermore, the testing is being conducted within an area impacted by a relatively low volume release that contained high solvent concentrations. Although unstated, the implied assumption is that pilot test conclusions can be extrapolated to the source areas associated with the IWL and ditches. However, the source conditions in these areas (very high volume of liquid release at relatively low solvent concentrations) are radically different from the source conditions in the vicinity of the pilot test (much lower volume of liquid release but probably much higher solvent concentrations). The pilot testing as designed will not provide the information necessary to quantify if vapor extraction will measurably accelerate restoration of the facility's groundwater over a significant portion of the groundwater plume. The pilot testing should include a component that studies source area contribution (i.e., percentage of contaminant from vadose zone versus groundwater), source area concentration/mass, and source area configuration that will be important in determining the scalability and general utility of this remedial methodology at TEAD.

SVE is not an appropriate presumptive remedy based only on the presence of soil vapor. It may be a presumptive remedy if soil gas is the driving force creating boundary groundwater quality violations, plumes expansion, or a completed risk pathway.

Section 1 of this report provides a brief overview of TEAD, the ITR process and its objectives. The ITR team's general recommendations are discussed in Section 2, and recommendations specific to the TNT Washout Facility, North Area Sanitary Landfill, IWL and Ditches with the Industrial Area Groundwater Sources are presented in Sections 3, 4, and 5, respectively.

We are pleased to note that TEAD has responded favorably (Appendix E) to the recommendations found in this report. They confirm that all Solid Waste Management Units are being evaluated through risk-based closure under Utah Administrative Code (UAC) 315-101. Most notably they are pursuing development of a site-wide strategic plan.

**Tooele Army Depot
Independent Technical Review**

DRAFT FINAL RECOMMENDATIONS REPORT

1.0 INTRODUCTION, LEGAL DRIVERS, AND REPORT OBJECTIVES

Introduction

TEAD is an active Army military installation (i.e., igloos, magazines, administrative buildings, an industrial maintenance area, military and civilian housing, roads, and vehicle storage hardstands, and other allied infrastructure) with a current mission to receive, store, issue, maintain, and dispose of munitions. Established in 1942, TEAD is located in Tooele Valley in Tooele County, Utah, immediately west of the City of Tooele and approximately 30 miles southwest of Salt Lake City.

TEAD was nominated for inclusion on the National Priorities List (NPL) in 1984 based on the identification of hazardous constituents at selected SWMUs, particularly the IWL and associated ditches. TEAD was placed on NPL in 1990. A Federal Facility Agreement (FFA) was entered into between the U.S. Army, U.S. Environmental Protection Agency Region 8 (EPA), and UDEQ in September 1991. The FFA addressed 17 SWMUs under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In 1991, TEAD was issued a RCRA postclosure permit for the IWL and ditches. The permit included a corrective action permit (CAP) that required action at 29 SWMUs. Additional SWMUs have since been added to the RCRA CAP, which is regulated by UDEQ. The TNT Washout Facility, North Area Sanitary Landfill, and Industrial Area Groundwater Sources are managed under the RCRA CAP program as Known Release SWMUs.

Legal Drivers

The principal legal driver for the sites addressed by the ITR at TEAD is the *Post Closure Permit for Post Closure Monitoring and Corrective Action of Solid Waste Management Units* (Postclosure Permit) issued by UDEQ in 1991. The Postclosure Permit is currently being reissued by the State. The Postclosure Permit sets out the regulatory requirements for the IWL (which is the only regulated unit at this time addressed by the permit) and the listed SWMUs. For the IWL, the permit requires continued postclosure care of the final cover, groundwater monitoring, and corrective action of the groundwater through the current pump and treat system. The current groundwater protection standard is based on the applicable MCL, which in the case of trichloroethylene (TCE) is 5 micrograms per liter (ug/l). The compliance point for the groundwater protection standard is currently the edge of the regulated unit (i.e., the boundary of the IWL). The reissued Postclosure Permit will allow for the application of alternate concentration limits (ACL) via petition if:

“The corrective action described ... fails to meet the groundwater protection standard... and after the Permittee has demonstrated that all other feasible methods have been used to meet the groundwater protection standard, or (*emphasis added*) if in accordance with R315-101, a risk assessment concludes that a contaminant concentration greater than the concentration limits specified ... poses no unacceptable risk to human health or the environment”.

For the listed SWMU's, the permit requires RCRA Corrective Action which follows the risk-based corrective action process using the RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) process which is outlined in Module VII and Appendix A and B.

In addition to the Postclosure Permit, the Utah RCRA Regulations at R315 also known as “the Risk Rule”, upon which the permit is based, will be legally applicable requirements for remediation. In particular, as to the SWMUs and regulated units addressed by the RCRA Postclosure Permit, it applies to all responsible parties managing a site contaminated with hazardous waste or hazardous constituents unless the site is cleaned up to background [R315-101-1(b)(1)]. Under the Risk Rule, the magnitude of the level of risk present at a site determines the degree to which actions must be taken. If the risk at a site is below 1×10^{-6} for carcinogens and a Hazard Index (HI) less than one, based on residential exposure, then no further action can be considered [R315-101-6(c)(1)]. If the risk at the site is less than 1×10^{-4} risk level for carcinogens based on the actual or potential land use exposures, but greater than 1×10^{-6} risk level for carcinogens based on a residential exposure and a HI less than one for both residential and the actual or potential land use exposure, appropriate site management controls (institutional controls, site security, postclosure care and monitoring) must be evaluated [R315-101-6(c)(3)]. When the risk level of 1×10^{-4} for carcinogens or a HI greater than one is exceeded based on the actual or potential land use exposures, corrective action measures must be evaluated [R315-101-6(d)].

In addition to the risk-based approach to remediation outlined in the permit and the Risk Rule, two separate requirements are set out in the Risk Rule, which apply regardless of the presence or absence of risk at the site. First, the Risk Rule requires the responsible party to “take appropriate action to stabilize the site either through source removal or source control” [R315-101-2]. Referred to as stabilization, UDEQ will require in part that, all continuing sources be removed or contained as a part of remediation. Secondly, the Risk Rule requires “when closing or managing a contaminated site, the responsible party shall not allow levels of contamination in groundwater, surface water, soils, and air to increase beyond the existing levels of contamination at a site when site management commences” (referred to as the principle of non-degradation) [R315-101-3].

Report Objectives

This report has been prepared to summarize the findings of the ITR team regarding remediation activities at the TNT Washout Facility, North Area Sanitary Landfill, IWL

and Ditches, and the Industrial Area Groundwater Sources. The primary objectives of the ITR team are to:

- Promote the use of realistic risk-based approaches as remediation decision-making tools
- Promote risk management approaches to ensure that the costs and benefits of remedial alternatives are properly assessed and balanced
- Identify opportunities to streamline the remediation process
- Provide expert technical assistance to the Installation.

To achieve these objectives, a multidisciplinary team of environmental subject matter experts was formed by the U.S. Army Environmental Center (USAEC), which executes the Army's Independent Technical Review program. The ITR team selected to conduct the TEAD review consists of seven subject matter experts, with expertise in the following areas: (1) decision analysis; (2) human health and ecological risk assessment; (3) hydrogeology; (4) vadose zone; (5) modeling; (6) environmental regulations; and (7) landfill technologies. Biographical information for each of the ITR team members is provided in Appendix B. Background on the Independent Technical Review program is provided in Appendix C and D.

The ITR team was provided background material and a briefing on investigations and restoration activities for the TNT Washout Facility, North Area Sanitary Landfill, IWL and Ditches, and the Industrial Area Groundwater Sources. The ITR team was asked to review and evaluate:

- Decision-making processes and technical approaches used at TEAD to address environmental restoration issues,
- Closure activities in progress at the North Area Sanitary Landfill, and
- Ongoing groundwater restoration and modeling activities.

The ITR team visited TEAD from September 25 to 28, 2000. This visit included: (1) an overview of the Installation's remediation programs at the TNT Washout Facility; North Area Sanitary Landfill; IWL and Ditches; and the Industrial Area Groundwater Sources; (2) a site tour; and (3) discussion/briefing presented by TEAD personnel, USAEC, U.S. Army Corps of Engineers (USACE), URS Dames and Moore, and Kleinfelder, Inc. Attendees at the discussion/briefing included representatives from UDEQ DSHW, EPA, and the ITR team.

2.0 GENERAL RECOMMENDATIONS

This section is provided to highlight recommendations that have the potential to effect decisions related to the entire restoration program for multiple sites at TEAD. These recommendations generally address issues concerning the overall management/direction of the restoration program or the general technical approach being taken rather than site-specific technical issues. If the ITR team's recommendations are implemented, the ITR team believes that significant cost and time savings can be achieved. Additionally, implementation of these recommendations can enhance the long-term technical defensibility of the projects.

2.1 Recommendation: A site-wide strategic plan with a conceptual model should be prepared for TEAD to coordinate remedial operations, promote proactive rather than reactive activities, and allow for prioritization of the clean-up effort.

Discussion:

A strategic plan would be appropriate for the groundwater issues associated with the industrial areas and the wastewater ditches and ponds. The effort would serve as a master plan for managing groundwater from investigation activities through final exit of active remediation and monitoring. The strategic plan should consist of the following elements:

- a. **Groundwater Management Goal** – This is a statement of the prime measurable end point of site activities. The measurable end point should be associated with elimination of realistic risk pathways.
- b. **Uncertainty Tree** – The uncertainty tree provides a map of all of the reasonably foreseeable outcomes and contingency options.
- c. **Decision Analysis** – Decision analysis is an identification of the criteria for alternative pathway selection at each uncertainty node.
- d. **Performance Standard Verification Plan/Exit Plan** – The Performance Standard Verification Plan (PSVP) establishes how success is to be measured. No action should be contemplated until the mechanism for measuring success is established, at least conceptually.
- e. **Tactical Implementation Plan** – The Tactical Implementation Plan establishes a master schedule for interrelated activities. This plan addresses all activities and their interrelationships, including regulatory interaction, from the present through measurement of corrective action success.

Groundwater Management Goal – It is proposed that the goal of groundwater management at the site should be expressed in the following form:

“Achievement of on-site contaminant concentrations in the vadose zone and groundwater that will allow groundwater concentrations at the site boundary to be maintained at or below MCLs”

The goal statement should address results and not digress into discussion of ARARS, EPA policy, or positions. These issues must be addressed, however, these issues are surrogate descriptors of an abstract objective of protecting human health and the environment. The goal in this instance is to protect human health and the environment by eliminating unacceptable contaminants at the point at which a risk pathway could be completed.

Uncertainty Tree Development – Uncertainty analysis consists of identification of the unknowns that could potentially be encountered in planning and executing groundwater management activities. Each node on the uncertainty tree represents conditions that are incompletely defined and could affect management decisions. The uncertainty tree includes consideration of non-technical issues such as regulator interpretation of regulations and third party issues.

The relative impact or importance of individual uncertainties is only partially understood in the early phases of strategic planning. As a project progresses the uncertainty analysis is continually updated to incorporate new information and changing conditions.

Decision Analysis – Decision analysis prioritizes uncertainties and identifies the criteria to address each uncertainty node. For example, there is significant uncertainty regarding the characteristics of vadose zone contaminants and the technical practicability of recovering such material. However, vadose zone chlorinated solvents may have little to no impact on groundwater restoration rates. The relative impact of vadose zone and groundwater solvents as a groundwater contaminant source is a primary uncertainty. If recovery of vadose zone contaminants is determined to be irrelevant to achievement of the management goal, data collection efforts should change dramatically.

For those uncertainties that remain truly significant, the decision analysis balances uncertainty reduction versus uncertainty mitigation. Uncertainty reduction is data collection for specific questions. Uncertainty mitigation is selection of action that is robust regardless of the answers to a particular uncertainty. As an example, a demonstration that a landfill's off property plume is contracting eliminates the need to thoroughly characterize the landfill interior.

The Data Quality Objectives (DQO) process is incorporated in the decision analysis. For most sites, there is a point at which uncertainty reduction becomes more costly than the benefits to be gained from further data collection. That defines the point of balance where the optimum approach incorporates uncertainty mitigation measures. This is the purpose of the DQO process. As stated in the introduction to the DQO guidance (EPA QA/G-6), “...it is the goal of the EPA and the regulated community to minimize

expenditures related to data collection by eliminating unnecessary, duplicative, or overly precise data.” By developing an uncertainty management plan, it is possible to identify and weigh the merits of data collection versus uncertainty mitigation so that an optimum course of action is identified.

An uncertainty matrix structured as follows aids decision analysis:

- a. Identify the parameter or condition that has an unknown or uncertain value (for example, concentrations of solvents within the vadose zone).
- b. Estimate the full range of values that the parameter or condition could possibly have, given the information currently available. An example is an estimate of potential TCE in the groundwater from the industrial ditches.
- c. Determine threshold values for the uncertain parameter or condition at which the decision would change. For example, TCE partitions to the soil within the groundwater. If the volume of TCE in the groundwater is greater than a certain volume, vadose zone TCE becomes irrelevant.
- d. Determine the significance of the uncertainty. If the range of possible values does not span the threshold value, or if there is no threshold value, the uncertainty will not affect the pending decision and is therefore not significant. No management strategy is required for insignificant uncertainty, and no further data are needed. If the uncertainty is significant, it is important to determine the comparative costs of reduction and mitigation to assist in selection of the optimal approach.
- e. For significant uncertainties, determine the cost and probability of reducing the uncertainty to a point where the range of probable values no longer exceeds threshold values.
- f. For significant uncertainties, estimate the cost of mitigating the impact of deviations from the assumed value.

Performance Standard Verification Plan - The Performance Standard Verification Plan provides the following:

- a. The objective of the activity being monitored,
- b. The performance criteria,
- c. The methodology for collecting data to measure the achievement of performance,
- d. The methodology (statistic) by which performance monitoring data will be compared against the performance criteria, and
- e. Decision trees defining the actions to be taken under different performance results.

Tactical Implementation Plan – The Tactical Implementation Plan provides a bridge between the Strategic Plan and subsequent Work Plans associated with individual projects. This component of the Strategic Plan identifies the major work tasks and master schedule.

Implementation Options:

A strategic plan as described above is most effectively implemented by a single entity. The responsible entity can be drawn from existing contractors, the USACE, or site personnel. The strategic planning should incorporate existing approaches but not be limited to such approaches or existing assumptions. An initial framework should be developed independently and then refined with joint sessions among the various stakeholders. The strategic plan must be dynamic in response to new information and changing political and regulatory environments. However, success is dependent on having a well defined, practical, and measurable objective and staying on message.

2.2 Recommendation: Compile site information into a single electronic database that would be available to and enhanced by all contractors that work at the facility. The modeling studies at TEAD should be consolidated into one activity.

Discussion:

A site-wide consistently maintained electronic database is critical for efficient decision-making. The importance of such a database is highlighted by the multitude of activities, contractors, and data sources that are now weakly coordinated.

The availability of data in an electronic format is a critical tool for environmental restoration projects. It greatly simplifies tasks such as data sorting and screening, statistical analysis, risk assessment, fate and transport modeling, trend analysis, exploratory data analysis, data posting, correlation analysis, and quality assurance. If data are not available from a single, central database, the contractors performing these tasks create their own databases and there are inconsistencies or inaccuracies in the data used. When the contract expires, the electronic data are often lost since the installation or executor is not interested in storing the electronic data. Failure to effectively use all existing data frequently results in duplication of effort and/or lack of understanding of the essential parameters necessary for the full understanding of the important issues at the installation, such as local ground-water/surface water interactions. This knowledge is essential to understanding the ability of contaminants to reach potential receptors and to understand the concentrations of contaminants of concern that might reach these receptors. Lack of a holistic understanding of the existing data and how new data would be used results in invalid data, increased study and cleanup time and the unnecessary expenditure of Army resources.

The environmental site assessments that have taken place at TEAD have resulted in the collection of fragmented pieces of geological/hydrogeological and environmental chemical data collected by multiple organizations, both governmental and private. Often, past results have not been fully taken into account when new investigations are planned. Sometimes this failure is due to ignorance of the existence of former work and sometimes due to uncertainties inherent in quality control/quality assurance in both the chemical and geological arenas of efforts undertaken by other organizations. The lack of knowledge and uncertainties can be minimized by the utilization of a single, central database for all the installation's environmental data, which can keep track not only of the past data, but also keep track of QA/QC methods utilized and the results of those QA/QC efforts.

Questions of data quality are not limited to chemical analyses as is often assumed. Of importance, especially in a hydrogeologic environment such as TEAD where well construction is so costly, are hydrologic parameters such as water levels (both ground and surface waters), well locations (in the x, y, and z directions) and the locations of other data points (SCAPS, Geoprobes, and so on). Other critical items include surveying accuracy, elevation benchmarks, methods utilized for surveying, and coordinate systems used. It is often of import to understand when water levels were measured (that is, how close in time were the analyses done, seasonal variations, and so on), and how the levels were taken and compared to the surveyed ground surface elevations.

Chemical laboratory analyses have been a source of much discussion over the years and it is very important to understand the QA/QC and DQO plans used in the collection of the data so as to insure that reasonable comparisons can be made between data using differing analytical methodologies. These comparisons can be made if the required QA/QC information is available in a convenient form such as provided by a single database.

Implementation Options:

Create a complete electronic database for all data collected at TEAD. There are several data management systems that could be used, including the soon to be implement AEC ERIS system. Modify future contracting efforts to include detailed specifications for data management. Arrange for training to ensure that selected TEAD personnel and contractors have access to the database and are able to use it as an analytical tool.

A site-wide GIS would be a common platform for analyzing the database due to the fact that most of the data are associated with existing geographical locations. GIS makes it much more convenient to view and analyze the data both spatially and sequentially. It is stressed that the GIS is an analysis tool that can be effectively used with a well-designed database. The GIS is not the database, nor should it be constructed to contain all the data. The GIS can be used to access data from the database on an as needed basis for rapid data analysis and communication with stakeholders.

2.3 Recommendation: Identification of the difference between risk-based or legal drivers versus judgment and preference should be established for each SWMU. Actions pursued at a SWMU should be based on a risk-based or legal driver.

Discussion:

A focal point of the ITR process is ensuring remedial decisions follow risk-based approaches while assuring all legal and regulatory drivers are met. Under the RCRA Corrective Action process, the fundamental goal is to control or eliminate risks to human health and the environment (61 FR 19441, May 1, 1996). Under RCRA Corrective Action, remedial actions are pursued based on the presence of unacceptable risk. In the absence of risk, remedial actions can only be justified by legal and/or regulatory requirements, which require actions regardless of risk. As discussed in Section 2.0, the Utah RCRA Corrective Action Program does provide two such regulatory requirements, stabilization and non-degradation of the site after the commencement of site management. In addition, at some sites other regulatory requirements such as closure requirements for RCRA regulated units may require action outside of risk-based considerations. At the TNT Washout Facility (SWMU 10), remedial actions did not appear to have any clearly defined risk-based or legal driver for remediation. Remedial decisions seemed to be driven by concentration levels rather than unacceptable risk through a defined exposure pathway. An additional consideration seemed in part to be a preference by UDEQ and the installation that removal of the limited volume of contaminated soil was beneficial when weighing economic cost and the benefit of a clean parcel. However, neither concentration levels nor cost/benefit analysis alone are risk-based or regulatory-based considerations to justify action. At the North Area Sanitary Landfill, capping actions were proposed based in part on closure of the landfill as a regulated unit; however, designation of the landfill as a regulated unit has yet to be fully resolved with the State. Before an action is based on a regulatory requirement or unacceptable risk, it must be clearly demonstrated and justified that an unacceptable risk exists and/or the regulatory requirement is triggered.

Implementation Options:

Through the RCRA Corrective Action process, the installation should clearly define the driver for any proposed remedial action whether it is risk-based, regulatory-based, or both. During the RFI stage and before the CMS stage, the installation should link the site-specific factors with risk-based and/or regulatory-based drivers to determine if remedial action is mandated.

2.4 Recommendation: Site-specific risk-based assessments should fully utilize current guidance and statistical data evaluation in the decision making process.

Discussion:

In general, Remedial Goals (RGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data. They are used for site "screening" and as cleanup goals if applicable. RGs are not *de facto* cleanup standards and should not be applied as such. However, they are helpful in providing long-term targets to use during the analysis of different remedial alternatives.

Comparison of maximum or 95% upper confidence level of the arithmetic mean exposure concentration to the RGs is a screening device that can be used for setting priorities, the emphasis is more on the comparative risk levels. For such screening exercises, additional site-specific data is rarely sought. However, decisions made in such cases should not involve direct cleanup or regulatory action without further refinement of the risk assessment (EPA Guidelines for Exposure Assessment, 1992).

By design, the risk assessment process is conservative and protective of human health and the environment. Using EPA's risk assessment guidance (EPA, Risk Assessment Guidance for Superfund, Part A (RAGS part A), 1989), risk is estimated using a single point (deterministic) approach based on a reasonable maximum value for the exposure. The outcome of the risk assessment is a set of risk and hazard estimates based on exposures to a single hypothetical individual, e.g., the military worker. The RGs are developed to protect an individual subjected to a reasonable maximum exposures (RME). The RME is defined as the highest exposure that is reasonably expected to occur at the site. By design, it is unlikely that actual risks existing at a site would exceed those estimated for the RME individual. RAGs part A indicates that the intent of the RME risk estimate, a single point "high-end" estimate of risk, is to estimate a conservative exposure case that is still within the range of possible exposure. The central tendency (CT) individual represents an average level of exposure. Generally, a risk manager could assume that risks at a site would be between those estimated for the RME and CT cases. Therefore, cleanup based on the RME individual could be considered to be protective of the potentially exposed receptors.

The commonly used default deterministic RME exposure assumptions that formed the basis for the TEAD risk assessment, when taken together, represent a "high end" estimate of risk, combining the various exposure parameters. The default approach uses high end and average assumptions in combination to represent a plausible estimate of high-end risk. When the default numerical values for the various exposure assumptions were first presented, the uncertainty in these assumptions was acknowledged, however, this uncertainty was never fully quantified for or communicated to the risk managers.

The RME approach gives a single risk number but does not reveal the uncertainties and variation in exposures underlying that number. While uncertainty can not be totally eliminated, it can be qualitatively or quantitatively assessed as suggested by more recent EPA directives (1992 Exposure Assessment Guidelines). The uncertainty analysis (EPA Risk Characterization Memo, 1995) stresses the need for transparency in

decision making process and clarity in communication regarding environmental risk and the uncertainties associated with the assessments. In doing so, disclosure of the scientific analyses, uncertainties, assumptions and science policies which underlie our decisions as they are made through the risk assessment and risk management processes, EPA has defined the “high end” of exposure as occurring between the 90th and 99.9th percentiles – a 10% range meets the NCP requirement to protect human health and the environment. For comparison, a few risk estimates are shown:

50 th percentile	7×10^{-9}
Central Tendency	9×10^{-8}
90 th percentile	2×10^{-7}
95 th percentile	6×10^{-6}
Default RME	1×10^{-5}
99.9 th percentile	9×10^{-5}

Four orders of magnitude of risk estimates exist between the average and the 99.9th percentile exposures and almost three orders of magnitude of risk exist for the RME risk distribution. These same risk estimates, span and exceed the acceptable risk range of 10^{-4} to 10^{-6} . Generally, cumulative excess cancer risk above the risk of 10^{-4} or HI greater than 1.0 is sufficient justification to consider possible remedial action at a site as indicated in the NCP, EPA, 1990). Therefore, risk managers must have sufficient information about the level of uncertainty surround the risk estimate in order to make a determination of remedial action and/or selection of remedial options.

One mechanism to deal with uncertainty or variation is the use of probabilistic risk assessment or Monte Carlo Analysis. However, that degree of complexity is generally not needed. This “sensitivity” or uncertainty analysis provides the risk manager the appropriate degree of clarity.

Implementation Options:

The most critical analytical data question to be answered before calculating the risk (and determining the remedial action) is the probability of false negatives or false positives. False negatives are of greater concern in the risk assessment than false positives, since false negatives may result in a decision that would not be protective of human health and the environment. False positives cause the calculated risk to be biased high, and are of concern because taking unnecessary action at a site is costly.

Prior to making remedial decisions based on the results of a screening risk assessment, the uncertainty underlying the risk assessment results should be recognized and addressed if necessary as part of the DQO process, previously discussed. Basing remedial decisions on a limited data set and employing the maximum soil concentration in the risk assessment may be acceptable in some circumstances. For example, if it is known that the contamination is uniformly distributed throughout the area of concern, then limited samples with little variability in sample concentrations can be relied upon to provide the basis for the risk assessment. However, if the data is highly skewed as in

the case of the TNT Washout Facility, the collection of additional data should be considered if it is likely that the data will reduce the uncertainty of the risk assessment and provide a firmer basis for remedial decisions.

Highly variable or skewed data can be identified in the TEAD risk assessment as those where the maximum concentration was employed rather than a 95% of the upper concentration limit (UCL). The maximum concentration was used when the 95% UCL exceeds the maximum concentration in the dataset. This information is useful in development of any additional data collection design. Any additional data collection should be consistent with the DQO process for the project.

To address concerns for false negatives (e.g., missing hot spots) or positives, adequate data (both in number and quality) must be obtained. Determining the minimum number of samples necessary to assure that the sampling is representative of the exposure conditions is a cost-effective method to reduce the uncertainty of the risk assessment for direct contact with soil and soil to groundwater exposure pathways and assist in making remedial decisions (EPA, Guidance for Data Usability in Risk Assessment, 1992). A geostatistical sampling pattern should be designed to fully delineate the surface and subsurface soil exposure strata to reduce the probability of false negatives (chemicals present but not detected by sampling design). These additional data should provide a robust dataset for statistical determination of the exposure point concentration, eliminating the need to use maximum concentrations. The existing data is likely judgmental/purposive sampling and are not recommended for estimating average and maximum exposure point concentrations within a stratum or domain area, but they can be used in geostatistical kriging estimations and can be included in recalculating risk.

2.5 Recommendation: Army policy requires that evaluation of no action (NA) and monitored natural attenuation (MNA) is included as remedial action alternatives.

Discussion:

The Corrective Measures Study Report (February 2000) prepared by URS Dames & Moore, identified four alternatives to address the TNT Washout Facility (SWMU 10). All of the alternatives included excavation. It is Army policy to consider no action (NA) and monitored natural attenuation (MNA) as remedial action alternatives. The *USAEC Restoration Oversight Managers Manual* (18 October 99), section 7.4.7, Installation Restoration Process Triggers, Feasibility Study [Corrective Measures Study], provides a checklist which identifies the consideration and evaluation of NA and MNA.

The basis for MNA is provided by the Department of the Army, ACSIM, Director, Environmental Programs, *Interim Army Policy on Natural Attenuation for Environmental Restoration* dated 12 Sep 95. It states:

“This memorandum provides interim policy for requiring the

consideration of natural attenuation as a remedial action alternative for installation restoration activities under the authority of CERCLA, RCRA, UST, NEPA, or relevant State and local regulations. This policy should be implemented immediately for decision documents or Records of Decision resulting from Army's environmental actions."

It goes on to identify that, "An engineered remedial action will not be approved unless data exists to prove that natural attenuation is inappropriate for a site cleanup."

The basis for NA is specific to CERCLA under Title 40 CFR 300.430(e)(6), which states that, "The no-action alternative, which may be no further action if some removal or remedial action has already occurred at the site, shall be developed." There is no similar reference under RCRA, but NA is a benchmark to compare all actions against.

Implementation Options:

Inclusion of NA and MNA is required and must be documented in all future consideration and evaluation of remedial action alternatives at Army installations.

3.0 TNT WASHOUT FACILITY

Introduction

The TNT Washout Facility was constructed in 1948 and operated intermittently through 1986. Operations at the facility included decommissioning projectiles, bombs, rocket heads, and other munitions filled with 2,4,6-TNT, composition B, cyclotrimethylenetrinitramine (RDX), and tritonal. The munition casings were decommissioned using steam to remove the explosives. The casings were then rinsed with water to clean residual explosive material, which was contained and sold or destroyed. Rinsewater was run through a horsehair filter and discharged to two outdoor steel-lined settling basins. The settling basins discharged through underground piping and aboveground ditches to the TNT washout ponds. The ditches and ponds were unlined.

Since 1982, it is reported that several previous investigations provided data on the nature and extent of contamination at this SWMU. A plume of groundwater containing explosive contaminants was identified but the full extent was not determined. The soils are reported to be contaminated with the highest concentrations located at depths of 15 to 30 feet adjacent to the TNT Washout Ponds. The TNT Washout ponds were closed in 1984. During closure the containment berms were pushed toward the center to fill depressions, a PVC liner was placed over the area, and the site was covered with clean soil.

Surface soil, sediment, and subsurface soil sample analysis detected RDX and 2,4,6-TNT above corrective action objectives (CAOs). Contamination above CAOs was laterally confined to the immediate vicinity of the washout ponds beneath the liner to a

depth of 5 feet below ground surface (bgs). Contamination from explosives was detected at concentrations below CAOs to a depth of 60 feet bgs in the vadose zone underlying the ponds. Groundwater samples collected downgradient of the ponds in 1988 contained RDX, 2,4,6-TNT, and 1,3,5-TNB, a byproduct of 2,4,6-TNT degradation. Subsequent groundwater samples did not contain 2,4,6-TNT and had very low concentrations of 1,3,5-TNB. Elevated nitrate/nitrite concentrations have been reported in all monitoring wells. Nitrate/nitrite concentrations are decreasing with time.

The Rust 1996 study divided surface soil (0 to 1 foot bgs) into two groups, the Old Ponds-South Group and the Old Ponds-North Group, to evaluate exposure to on-site workers, off-site residents, and potential future on-site residents. A third group of soil samples (1.5 to 10 feet bgs) was used to evaluate exposure to future construction workers.

The reported cancer risk and HI for depot personnel, (depot personnel are equivalent to on-site workers of Rust, 1996) given the current land use scenario, for the Old Ponds-South Group were 1.3×10^{-5} and 2.1, respectively. The Old Ponds-South Group includes four soil samples (TNT-SB02-1, TNT-SB03-1, TNT-SB06-1, and TNT-SB22-1; Rust, 1996) collected from a depth range of 0 to 1 foot bgs. These samples are located in the vicinity of a single pond just north of building 1245. The cancer risk and HI for depot personnel given the current land use scenario for the Old Ponds-North Group were 1.8×10^{-8} and 0.14, respectively. The Old Ponds-North Group includes six soil samples (TNT-SB9-1, TNT-SB13-1, TNT-SB14-1, TNT-SB30-1, TNT-SB31-1, TNT-SB32-1, and TNT-SB33-1; Rust, 1996, Figure 7-16) collected in a depth range of 0 to 1 foot bgs. These samples are located in and adjacent to a group of small ponds east of the larger north-south trending line of ponds and beyond the northern-most washout pond. It is unclear why the intervening soil samples collected from within the north-south trending line of ponds (i.e., TNT-SB23-1, TNT-SB24-1, TNT-SB21-1, TNT-SB25-1, TNT-SB26-1, TNT-SB27-1, and TNT-SB28-1, Rust, 1996) at a depth range of 0 to 1 foot bgs were not used in the risk assessment of the TNT Washout Facility. The reported cancer risk and HI for future construction workers were 6.1×10^{-7} and 12, respectively. However, soil samples included in the evaluation of the future construction worker scenario appear to include the interval from 0 to 10.5 feet bgs (see Table 7-9, Rust, 1996). In general, the concentration of explosives in the 0 to 1 foot bgs interval are higher relative to other samples collected from 2 to 11 feet bgs.

3.1 The TNT Washout Facility (SWMU 10) should be better characterized with existing or new data, if necessary, to recalculate risk and evaluate alternative corrective action alternatives that meet Army policy and eliminate unacceptable pathways.

Discussion:

Two critical elements (exposure pathways) of the risk assessment for TNT Washout Facility (SWMU 10) should be considered prior to remedial action selection. First, the

direct contact soil exposure pathway (the measurement of exposure point estimate) and second, the indirect soil exposure pathway (soil to groundwater migration).

The existing data appear to be inadequate to characterize the risk from direct contact or soil to groundwater migration. The latter exposure pathway was not addressed in the risk assessment and the former is based on considerable uncertainty including data quality issues. The HI to depository workers is based on one sample (maximum surface soil concentration) taken 0-1.5 feet below the PVC liner. At this time and in the foreseeable future, the PVC liner controls this exposure pathway. Nonetheless, the number of soil samples and distribution of their locations are not adequate to characterize contaminant distribution in the soil for the 14-acre SWMU. The existing data may be biased and the data points are too few with both of these factors causing in a high degree of uncertainty. Additional surface and subsurface soil samples would be necessary to reduce the uncertainty in the exposure point concentration.

The indirect exposure pathway from soil to groundwater has not been assessed. While shallow groundwater is impacted, it is uncertain if the soil represents a continuing source sufficient to create or maintain elevated contaminant concentrations in groundwater beyond the footprint of the SWMU. However, ground water time series data near the TNT facility indicate that contaminants are degrading and that the impacted groundwater has not migrated a significant distance downgradient of the site. It is probable that excavation volumes can be significantly reduced through a modest expanded sampling of the TNT ponds. The intent is to provide pre-excavation sampling to further characterize the soil volume to be removed and establish performance standards for excavation (i.e., what soil should be removed and what soil should remain in place).

Implementation Options:

Generation of the pre-excavation contaminant characteristics and performance standards can be achieved with a sampling program that results in approximately 12 samples total at two depths, (vertically averaged over 0 to 2 and 2- 10) in each of the four ponds. Excavation would then be limited on those areas that create an exceedance of a performance standard (e.g., direct contact risk-based).

The above approach will result in soils that exceed performance standard being left in place. The performance criteria should be achievement of an average concentration over the entire domain of exposure and not removal of all soil. Localized high concentrations need only be removed if the contaminants exceed acute exposure concentrations (i.e., those concentrations based on an acute rather than chronic reference dose).

The above approach should also be coupled with assessment of the feasibility of alternate soil disposal options based on contaminant concentrations and the volume of soil removed. The remedial action plan should remain flexible throughout the clean up to allow for alternate soil disposal options, as needed.

A remediation flow chart of the decision process for the TNT Washout Facility is provided on the following page.

4.0 NORTH AREA SANITARY LANDFILL (SWMU 12/15)

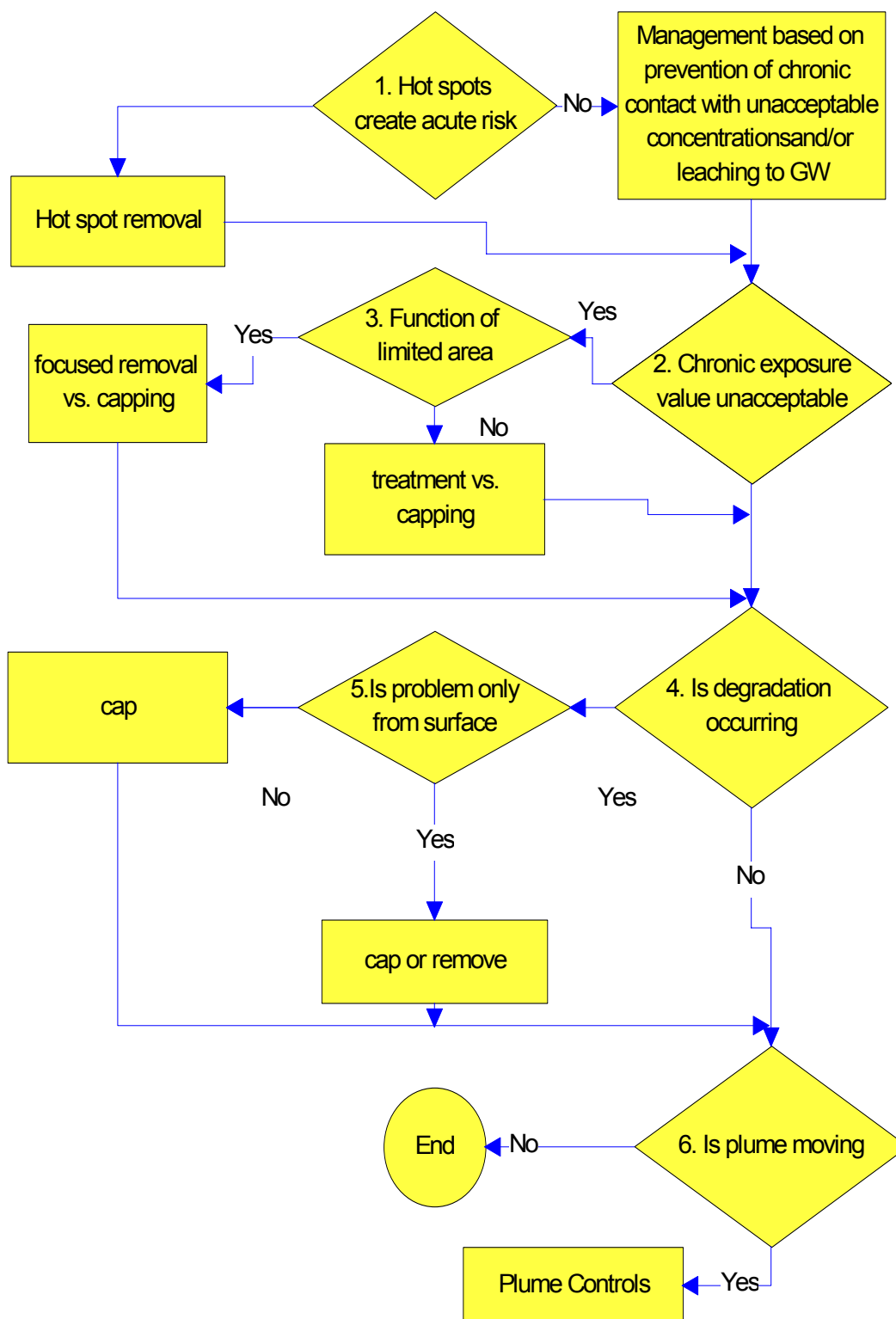
Introduction

The North Area Sanitary Landfill that includes the pesticide disposal area (SWMU 12/15) was established in 1942 and received residential and industrial waste until 1996. Small amounts of asbestos, pesticides, and solvents were included in the waste materials but it is reported that no hazardous waste was deposited in the landfill after October 1980, when the RCRA Management Plan was implemented. In the CMS, the landfill is described as an interim status hazardous waste landfill based on disposed waste characteristics and a review of Utah's regulatory definitions and classifications of wastes and landfills. Based on this assessment, it is assumed that the site will be closed in accordance with the Interim Status Requirements for Hazardous Waste Facilities (UDEQ Hazardous Waste Rule R315-7). The landfill has never been permitted by UDEQ and its classification has not been determined.

A review of aerial photographs indicates that landfill activities took place within approximately 120 acres. It is not known what percentage of this area received trash. Disposal of waste material occurs in topographic low areas and along the northwest-southeast trending arroyo that bisects the property. The RFI reports that trash was buried in single lifts greater than 8 feet thick. The reported maximum thickness of waste is approximately 30 feet in the north-central portion of the landfill. Landfill debris was covered with an unknown thickness of soil (i.e., generally 2 feet or less). There are a few small areas of exposed trash.

The landfill is not producing significant quantities of methane or other landfill gasses. This suggests that either the later methanogenic phases of decomposition that effectively convert organic compounds to landfill gas are complete or the residential and industrial waste deposited at the site did not contain a significant amount of biodegradable organic material. Because waste was received at the landfill until 1996 and a landfill is essentially an anaerobic digester with a hydraulic retention period of many decades, it is assumed that the waste did not contain a significant amount of organic material.

A health risk assessment of the landfill has been performed and found that the current land use by Depot personnel has a cancer risk and HI of 1.5×10^{-5} and 0.18, respectively. A future construction worker was found to have a cancer risk and HI of 1.2×10^{-6} and 1.6, respectively. With this level of risk, active corrective measures are not necessarily required at the landfill.



TNT Washout Facility Remediation Flow Chart

There are two principal issues associated with the landfill; 1) relationship between landfill contaminants (principally TCE) and groundwater quality beyond the landfill footprint, and 2) is the current cap (with repair) sufficient to prevent contaminated groundwater from migrating beyond the SWMU boundary. These issues are addressed in the following two recommendations.

- 4.1 Recommendation: Future activity at the North Area Sanitary Landfill (SWMU 12/15) should initially focus on 1) repairing the cover to eliminate exposed debris and 2) establishing if the groundwater plume associated with the landfill is stable, expanding, or contracting. Subsequent investigations, assessment, and installation of control measures should be implemented only if necessary to prevent the plume beyond the landfill boundary from expanding.**

Discussion:

Landfill Cover – The reported presence of exposed debris at the landfill is unacceptable. Maintenance and repair of the existing soil vegetative cover is a low cost action item that will reduce exposure of Depot personnel to trash and eliminate the physical hazards created by this material. The ITR team recommends that native soil be used to cover all area of exposed trash. This action item could be accomplished in conjunction with the additional trenching proposed to further define the aerial distribution of trash.

Source Investigation – Groundwater contamination has been identified in and downgradient of the landfill. Soil gas and soil sampling during the RFI in 1996 identified fourteen volatile organic compounds (VOCs) consisting predominantly of TCE and 1,1,1-TCA. The soil-gas survey indicated a broad area in the western portion of the landfill had detectable TCE in soil gas. However, soil samples collected from test pits at a depth of 10 feet bgs contained no detections of TCE. A test pit installed near an anomalously high concentration of 1,1,1-TCA found decreasing concentrations of TCE and 1,1,1-TCA from the ground surface to a depth of 10 feet and did not encounter a buried source of the VOC contamination at that location. The soil gas survey detected VOCs at low concentrations and did not show any trends that would indicate a significant subsurface source area. No significant surface or subsurface source areas have been identified.

To further refine the probable vertical distribution of soil TCE, two vertical soil gas-monitoring stations, Seamist wells, were installed. The location of these wells was based on elevated soil gas concentrations from the soil gas survey. The wells were installed in the vadose zone to depth of approximately 20 feet above the highest anticipated groundwater elevation. The Seamist wells provide a profile of VOC concentrations throughout the vadose zone.

Findings from the Seamist monitoring stations indicate that detectable concentrations of VOCs are present in the vadose zone soil gas to the depth sampled. The interaction

between the VOCs in the deep vadose zone and groundwater is not known. The Seamist boreholes did not penetrate groundwater and no monitoring wells are located near these soil gas-monitoring stations.

Investigation and Remediation Criteria – Although uncertainties exist regarding the distribution of source material, the appropriate issue is the likelihood that source material is relevant to risk management objectives. The empirical evidence is that source material, regardless of its location and distribution, is not creating a measurable off-site impact.

Regulators have indicated a belief that the soil gas survey is insufficient to define small VOC source areas. However, the prime question is the relevancy of remnant soil gas or small VOC source areas to the objective of protecting groundwater beyond the footprint of the landfill. A review of groundwater data indicates that VOC concentrations are decreasing with time and distance downgradient of the landfill. If the plume is collapsing back to the landfill boundary under current conditions, extensive searches and treatment of small sources provide little value in achieving the objective.

The characteristics of the plume should be investigated with a groundwater-monitoring plan that allows statistically valid conclusions regarding the significance of trends. A more detailed investigation of soil gas is necessary only if the results of the monitoring demonstrate that the groundwater beyond the boundary of the plume is not already improving. If the contaminant flux across the landfill boundary exceeds the existing attenuation rates, an expanded source investigation may be merited.

Implementation Options:

A site-specific monitoring program using the existing monitoring wells should be developed for this SWMU. It should include indicator parameters that can be used to evaluate the on-going impact of the buried trash on groundwater quality beyond the boundary of the landfill. Indicator parameters could include calcium, magnesium, sodium, or potassium (common landfill cations) or phosphates, nitrates, chlorides or sulfates (common landfill anions). In addition, specific conductance, total dissolved solids, metals, and VOCs are typically used to evaluate landfill impact. Indicator parameters, when possible, should be selected from those constituents that are part of the existing monitoring program.

The groundwater wells within and downgradient of the landfill should be monitored each sampling event for parameters selected for this SWMU. An expanded time series of data from wells downgradient of the landfill is necessary to evaluate groundwater quality trends associated with the presence of buried trash at the site. The time series should consist of a sampling from the downgradient wells every six months for two years. At that time, the frequency of sampling and the number of wells should be reduced if groundwater conditions are shown to be stable or improving.

In addition, a comparative statistical evaluation of indicator parameter concentrations up- or sidegradient versus downgradient of the site should be performed. The presence of indicator parameters with TCE would be anticipated in the downgradient monitor wells if this solvent were discharged into the landfill with the residential or industrial waste material.

The ITR team recommends that TEAD, UDEQ, and EPA personnel apply EPA's DQO process to determine the uncertainties that must be resolved. The exercise should address the measurable risk associated with uncertainties regarding soil vapor sources within the landfill.

EPA released its revised DQO guidance document in August 2000 (EPA/600/R-96/055). The DQO process is a method to clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors to establish a basis for the quality and quantity of data needed to support decisions. It is a seven-step planning approach to develop sampling designs for data collection activities that support decision making. Due to the specific nature of the question to be addressed at TEAD, several of the initial planning steps (i.e., state the problem, identify the decision, identify the inputs to the decision, define the boundaries of the study) are already understood. However, guidance for step 5, Develop a Decision Rule, and step 6, Specify Tolerable Limits on Decision Errors, would be useful in resolving the question of adequacy of the soil gas survey.

For example, the critical question is whether the groundwater plume is collapsing back to the landfill boundary under current conditions. The ITR team must collectively determine the confidence in plume conditions necessary to terminate further source investigations. Additional soil gas data may be required if the probability of the occurrence of decision errors is intolerable (e.g. there is only a 50% probability that the plume is collapsing, and the ITR team decides the confidence must be 90%).

The DQO process provides guidance for optimization of the design for obtaining additional data. The Decision Error Feasibility Trials (DEFT) Software for the DQO process (EPA QA/G-4D) allows the user to change DQO constraints such as the limits on decision error and evaluate how these changes affect the sample size for a selected sampling design. The average unit cost of analyzing a sample and the average unit cost of field sampling are used to compute the total cost of a sampling design.

If groundwater data is inconclusive due to the need for a longer time series of data, an empirical approach could be used to obtain a near-term estimate of the probable significance of source areas present at the landfill. If the impact to groundwater quality at a "worst case scenario" were tolerable, then smaller source areas would not be expected to have a greater impact and, therefore, would also be considered tolerable. Presumably, the Seamist wells were installed at locations that are believed to be a significant source of groundwater contamination. If the proposed vadose zone and groundwater studies, discussed later, for these source areas do not indicate a

continuing source area of contamination, can it be agreed that smaller source areas at the landfill would be tolerable.

The ITR team recommends that a modest amount of additional field and modeling studies be performed to determine if there is a continuing source of TCE at the landfill that is adversely impacting groundwater quality. Field program would include preparing a work plan and drilling one additional groundwater monitoring well downgradient and adjacent to the Seamist well that has the greatest concentration of TCE in the vadose zone soil gas near the groundwater table. The work plan would specify the data collection procedures used during the drilling program. Field data collection should focus on collecting input parameters to model the interaction between the vadose zone and groundwater. A groundwater sample should be collected at the same time a vertical profile of vadose zone soil gas samples is collected from the Seamist well. These data should be used to empirically evaluate the impact of TCE soil gas on groundwater quality.

It is recommended that the interaction between the soil gas in the vadose zone and groundwater be modeled using a one-dimensional finite difference vadose zone leaching model program such as VLEACH. If the one-dimensional vadose zone modeling identifies realistic conditions under which the vadose zone could provide unacceptable contributions to saturated zone contaminant concentrations, more sophisticated three-dimensional variably saturated zone modeling may be necessary. The FEMWATER code in the GMS is one such code that has been used at Army and other DOD sites for such purposes.

The modeling study should focus on understanding the minimum size of a vadose zone source that would impact groundwater quality. This information should be used to further evaluate if a significant and continuing source of contamination is present at the landfill.

4.2 Recommendation: The North Area Sanitary Landfill (SWMU 12/15) is classified by UDEQ as a SWMU and should proceed with a risk-based closure.

Discussion:

It is the ITR team's understanding, based on information presented by a representative of UDEQ at the Technical Review Committee meeting held on January 24, 2001 at TEAD, that the State considers the landfill a SWMU that should be closed in a manner that is protective of human health and minimize ecological hazard. The condition to limit erosion and maintain the soil cover has been previously documented in correspondence from UDEQ to TEAD.

Implementation Options:

The ITR team recommends that TEAD develop a risk-based closure plan that is protective of human health and addresses ecological hazard, as needed. **The ITR team believes that the cost of the CMS's "presumptive remedy" for the landfill (i.e., a RCRA type landfill cover with postclosure maintenance and monitoring) is not appropriate for the modest health and ecological hazard posed by the site. It is the ITR team's understanding that the State holds a similar opinion.**

The performance criteria for closure activities at the North Area Sanitary Landfill should be to prevent exposure of debris. The performance criteria should not include prevention of infiltration. This can be achieved if the monitoring effort demonstrates that the plume is collapsing under current conditions. If this is demonstrated, infiltration does not require control for the purpose of protection of off-site groundwater.

5.0 GROUNDWATER REMEDIATION/INVESTIGATIONS AT THE IWL AND DITCHES, AND THE INDUSTRIAL AREA GROUNDWATER SOURCES

Introduction

TEAD was established in 1942 to provide storage, maintenance and demilitarization of troop support equipment especially wheeled vehicles and conventional weapons. From 1942-1966, large quantities of hazardous materials were used and generated in these operations in the industrial area. During this time period, the waste chemicals were piped through the industrial complex into a set of four unlined drainage ditches. These ditches ended at a set of natural depressions that were used as evaporation (and infiltration) ponds. These ponds have been called the old industrial waste lagoon. In 1966, a collector ditch was constructed to intercept the four existing ditches. This interceptor ditch ran north approximately 1.5 miles to an abandoned gravel pit. This gravel pit, the IWL was used as an evaporation pond until its closure in 1988 when an industrial wastewater plant was brought on line. The primary contaminant of concern was TCE used as a solvent in the repair operations of military equipment.

In 1983, the Army began investigating sources of contamination contributing to a plume of TCE that originated in the southeast portion of the Industrial Area and extends approximately 3.3 miles to the northwest. This plume was believed to have originated in the wastewater discharge through the unlined ditches to the original and then new evaporation ponds. A groundwater pump and treat system was put in place to treat this plume and prevent TCE concentrations greater than MCLs from crossing the property boundary. By the mid- 1990's however it became apparent that there was contamination traveling from the industrial area to the northeast that could not have originated in the IWL system and must therefore have originated somewhere in the industrial area or perhaps in the Defense Reutilization and Marketing Office (DRMO) yard.

Groundwater flow trends in a northwest direction across TEAD. The main exception to this appears to be the NE plume which bends around a bedrock outcrop. Uplifted,

fractured bedrock in the central area of the Depot is a controlling hydrogeological feature. In general, the Depot can be divided into three separate hydrogeologic regimes, 1) the steep flow gradients of the fractured bedrock and adjoining low conductive alluvium in the central area of TEAD; 2) the highly transmissive alluvium in the northern part of the Depot and 3) the shallow alluvium at the southern upgradient end of the site. The uplifted bedrock block and adjoining low conductive alluvium are the hydraulically controlling features of the study area due to the steep gradients required for flow across this area. The uplifted bedrock block strikes roughly east-northeast and dips north-northwest. On the local scale the bedrock block exhibits strongly heterogeneous hydrogeology typical of fractured flow environments. Flow through the bedrock block consists of a steep gradient when entering the bedrock, a flatter gradient through the bedrock core and a steep gradient when exiting the bedrock.

There are several important issues that are raised by the groundwater investigations/remediation. These include establishing the location of compliance boundaries for meeting regulatory MCLs and how to determine if the on-going and proposed remedial efforts are helping to meet the compliance goals. These issues are addressed in the following recommendations.

5.1 Recommendation: TEAD should develop compliance boundaries and establish source area performance standards that maintain MCLs at the property boundary.

Discussion:

There are two principal source areas that contribute to groundwater contamination at TEAD. The Northeast Plume is originating from a recently identified point source in the industrial area, the oil/water separator at Building 679. The Main Plume originates from several source areas within the industrial area and the IWL. Appendix B of the Postclosure Permit, Corrective Measures Study and Implementation, requires the establishment of site-specific objectives for corrective action (Task I, B). The site-specific objectives are required to be based on public health and environmental criteria, (i.e., EPA guidance), and applicable State and federal statutes (Id.). EPA and Utah RCRA regulations allow TEAD to address commingled releases derived from several regulated SWMUs as one waste management area when the releases originate from several sources [R315-8-6.6(b)(2); 40 CFR 264.95(b)(2); 61 FR 19450, May 1, 1996].

The waste management area is within the imaginary line circumscribing the original sources of contamination (Id.). At TEAD, the IWL and the industrial area should be considered one waste management area with the circumscribing line as the point of compliance (POC) and the point of exposure (POE) located at the downgradient property boundary. This could be accomplished through the existing ACL process as outlined in the Postclosure Permit. The permit allows for an ACL to be granted, if a risk assessment concludes that a contaminant concentration greater than the concentration limits specified poses no unacceptable risk to human health or the environment.

In granting an ACL, UDEQ is allowed to consider several factors including: hydrological characteristics, direction of groundwater flow, current and future groundwater uses, potential for human health risks, and proximity and withdrawal rate of groundwater users [R315-8-6.5(b) (which follows 40 CFR 264.94(b))]. Using these factors, an ACL is established consisting of the POC, (i.e., the imaginary line defining the waste management area boundary), and the POE. At TEAD, there is no groundwater on-site route of exposure and this pathway is first completed by the potential future residential receptor at the installation boundary. Therefore, the installation boundary can be established as the POE. In such instances, the point of compliance is separate from the point of exposure thus fate and transport characteristics, including attenuation are considered when calculating the ACL. The ACL is determined by a contaminant concentration at the POC that will attain a concentration at the POE that is protective of human health and the environment taking into consideration the attenuation of contaminants between the POC and the POE. For the IWL/Industrial waste management area, the ACL would be the concentration of TCE at the POC that will result in a concentration of 5 ug/l of TCE at the POE.

As an alternative to the ACL process, the State may utilize the flexibility in the Utah RCRA regulations that allow deferral of the closure of the regulated unit to a risk-based closure, which is protective of human health and the environment [See R315-8-7, which incorporates by reference 40 CFR 264.110 (1998) and the amendments to that rule by the Final Rule for Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities at 63 FR 56709, October 22, 1998)]. The October 22, 1998 Final Rule amended the RCRA Closure requirements to allow UDEQ to apply alternative requirements which replace the general closure and postclosure and the unit specific closure and postclosure requirements that are protective of human health and the environment [40 CFR 264.110(c)]. This relief is available for any unit situated among other SWMUs that have contributed to a common release. The final rule indicates that permits may be revisited at previously closed facilities when new information arises after issuance of the permit, which may warrant deferral of regulated unit requirements (63 FR 56725, October 22, 1998). If a risk-based closure approval is granted for the IWL/Industrial area, it could be remediated as one waste management area as discussed below (which parallels the ACL process).

The Northeast Plume will not require an ACL since the source of the plume (the oil/water separator at building 679) does not include a regulated unit. ACLs are established in the RCRA program as part of the Subpart F requirements (groundwater protection) for permitted units. The ACL permits the UDEQ to allow for risk-based standards and natural attenuation as an alternative to remediation to background/maximum concentration approach as required by the RCRA regulations [R315-8-6.5(a) (which follows 40 CFR 264.94(a))]. In contrast, when addressing SWMUs under RCRA Corrective Action, the risk-based approach already encompasses both concepts of the ACL. Under RCRA Corrective Action, groundwater protection standards are established which are site-specific levels that reflect the potential risks by considering the exposure pathways, toxicity characteristics, and fate and transport of the contaminant (61 FR 19449, May 1, 1996). For groundwater, the potential future

exposure occurs at the property boundary for residential use based on designation as drinking water. From this potential pathway, a numerical value should be calculated based on exposure and toxicity that result in a contaminant concentration that is protective of human health and the environment (i.e., TCE = 5 ug/l). Like regulated units, RCRA Corrective Action generally sets the POC at the edge of the unit or boundary of the waste management area; however the groundwater cleanup level takes into account groundwater uses and likely exposures (*Handbook of Groundwater Policies for Corrective Action*, pages 23-24, USEPA, Office of Solid Waste, EPA530-D-00-001, April 2000 Draft; 61 FR 19450, May 1, 1996). The groundwater cleanup level should then be calculated as the concentration of contaminants at the POC, which will attain the concentration that is protective of human health at the POE (*Handbook of Groundwater Policies for Corrective Action*, page 20, USEPA, Office of Solid Waste, EPA530-D-00-001, April 2000 Draft; 61 FR 19449-19450, May 1, 1996).

A tertiary TCE plume that is downgradient of the Northeast Area Sanitary Landfill and upgradient of the Main Plume should be addressed consistent with the conceptual model developed for the site. If the landfill is identified to be the sole source of the contamination then the POC should be addressed similar to the Northeast Plume, as discussed above. However, if the TCE at the landfill is identified as originating from or in part from the industrial area, the landfill should be incorporated into the IWL/Industrial waste management area.

5.2 Recommendation: TEAD should develop a site-wide monitoring plan that is consistent with and addresses critical uncertainties of the strategic plan.

Discussion:

The ITR team noted that data collection at TEAD is not performed on a regular basis to determine specific trends and establish adequate baseline conditions. It was apparent that most data was collected in response to specific issues or concerns. This has limited the utility of the existing data for purposes of assessing larger scale and long-term issues (for example, effect of soil vapor extraction systems on water quality, hydraulic changes due to existing and proposed pump and treat systems, and the influence of any new remedial action).

The ITR team recommends that TEAD revise the sampling program on a site-wide basis to address uncertainties identified in the strategic plan. For example, site-wide water-level measurements should be collected on a regular quarterly basis. These data could be utilized to evaluate hydrologic relationships around the site and provide the basis for assessing potential contaminant migration conditions. More frequent sampling of groundwater wells throughout TEAD for a smaller number of indicator parameters should be considered.

Implementation Options:

The ITR team recommends a consistent site-wide monitoring and data collection program be implemented in order to support ongoing refinement of the site conceptual model and better understand the efficacy of removal actions completed to date. The monitoring plan should include specifics such as the wells and analytical suites to be monitored, the objective of the data collected from each well, the decision criteria by which the results will be assessed, and the actions or decisions that will follow from different analytical results.

5.3 Recommendation: The Hydrologic Engineering Center (HEC) groundwater model should be utilized to evaluate flow characteristics on the eastside of the bedrock area and study dissipation of the groundwater mound under the IWL.

Discussion:

Several models and modelers have been used at TEAD to study a variety of groundwater flow issues. There are still issues to be addressed and a decision must be made as to which of the developed models should be used for future studies. The main questions to be asked in this regard are: 1) Can the MODFLOW model developed by HEC with its geometric, geographic, and saturated flow limitation continue to provide the numerical simulations necessary in the future? and 2) Should more advanced models within GMS, such as FEMWATER, be used for future studies where unsaturated flow and transport issues will be more important? In addition, the selected model should be capable of addressing the following questions:

- a. What are the regional impacts of TEAD contamination on the Tooele Basin?
- b. How did the introduction of contamination from the IWL and ditches impact the short-term and long-term movement of contamination?
- c. How does contamination in the unsaturated zone affect contaminant levels in the groundwater aquifer?
- d. How should the existing pump and treat operation be optimized to maximize capture/removal and minimize pumping/cost?
- e. How effective is monitored natural attenuation as a remediation method?

Regional impacts on the Tooele Basin can be modeled with much finer resolution and better accuracy (relative to the USGS regional model 2000-ft resolution) for comparatively little funding. The motivation for doing this would be to obtain the accuracy needed to generate boundary conditions for smaller inset models of specific

remediation sites. HEC used this approach in modeling flows in the Northeast Plume area. However, using fluxes and/or groundwater elevations from the coarse resolution USGS regional model to generate boundary conditions for the finer resolution HEC model can, by itself, cause inaccurate flow and transport responses in the Northeast Plume area east of the bedrock outcrop. The flow vectors in this area from the HEC model indicate a boundary effect that is probably an artifact of model structure. It is important to remember that the purpose of the USGS model was to simulate regional scale hydrogeologic processes. It is problematic to accept its output as truth (i.e., real boundary conditions) in a much finer scale model that has entirely different purposes.

The effects of the previous mounding of groundwater and contamination under the IWL and ditches can be modeled to determine impact on the distribution of contamination in the groundwater. Given rough estimates of flow and transport from installation operations, the shape and extent of the plume could be estimated from its introduction to the present. Simulations could also be performed to determine the best approach to containing and treating the contamination.

Models can be used (with source terms provided by unsaturated zone contaminant samples) to determine vadose zone cleanup concentrations. If there is value in remediating soils, models can be used to estimate surface and subsurface soil contaminant concentration limits where diminishing remedial returns would be expected. Both 1- and 3-dimensional flow and transport models could be useful to accomplish this task. GMS has several 3-dimensional models that could be used over a small inset area to simulate predominantly vertical, unsaturated flow and transport mechanisms.

Optimization of the pump and treat system will involve modification of pumping amounts and perhaps the relocation of pumping and/or injection points. The model selected for this task must be capable of doing simulations with minimal modification since numerous scenarios are required with local refinement of the grids or meshes near wells. Optimization studies are sometimes performed on top of flow models that do not have sufficient resolution to accurately simulate flow and transport processes throughout the model domain. Therefore, the model must be sufficiently large in geographic coverage to accurately simulate the range of new well locations that are possible without introducing boundary condition effects or grid induced error.

Monitoring natural attenuation as a remediation method requires simulated flow and transport in 3-dimensions over the entire installation and beyond to potential receptors. This means accurate simulation of groundwater elevations/heads, groundwater velocities, and the contaminant transport processes associated with natural attenuation. The model must have sufficient resolution to capture both flow and transport gradients. It should be able to test various distributions of contaminants in 3-dimensions that are the result of different levels of active remediation and be able to determine the effectiveness of natural attenuation of contamination throughout the model domain.

Implementation Options:

Modeling at TEAD should be conducted using GMS. Future modeling studies whether they are regional or insets, saturated or unsaturated, flow and/or transport should be conducted using GMS. GMS has all of the models and capabilities necessary to handle future modeling activities at TEAD.

New conceptualization data (stratigraphy and heads from wells) should be used to extend the lateral coverage of the existing HEC model in the area east of the bedrock high. The current model should also be used in this area to test alternative methods of specifying boundary conditions. As they currently exist, groundwater vectors just east of the bedrock high are impacted by the specification of heads along the boundary to the point where contributions to the extraction wells can be impacted. No-flux boundary conditions in this area should be avoided because it creates boundary parallel vectors regardless of head gradients observed in the field. Additionally, direct coupling to boundary conditions (heads or fluxes) from the regional scale USGS model should be avoided if at all possible. Using interpolated field data in this region is as likely to produce realistic flow directions and fluxes and using the regional model data.

In the IWL area, the HEC flow model should be used to evaluate the saturated zone effects of historical and present recharge rates into the IWL area. Historical simulations can be used to determine mounding from higher recharge rates and to infer travel and residence times in the contaminated areas. Transport modeling should also be done in concert with the HEC model to determine the fate of the contamination in this area. The HEC model cannot be used to evaluate vadose zone flow or transport processes, which can factor into remediation decisions in the IWL area. If this model study were beginning today, it would arguably be better to use a variably saturated, unstructured (typically finite element) 3-dimensional model to tackle most of the problems at both the IWL and the bedrock outcrop areas. However, a significant effort has been exerted using the chosen technology and should not be abandoned as long as saturated zone processes continue to dominate the remediation issues and requirements.

The modeling activities should be consolidated into a single activity. There appears to be several efforts in the modeling activities that are not completely coordinated or complimentary. The selection of boundary conditions, grid spacing, and levels of calibration should be standardized for modeling efforts. While modeling has and will be conducted to answer different questions (i.e., regional vs. local scale, saturated vs. unsaturated flow and transport, etc.), consistent conceptual and numerical models should be developed. A single conceptual model for the entire facility should be developed from which regional and local numerical models will be constructed.

Regional boundary conditions (heads, recharge, etc.) must be adopted that are representative. This may require different sets of boundary conditions for different hydrologic conditions. However, they should be applied consistently for all models.

Sharing of boundary conditions at the edges of models with different scales, grid resolution, and numerical formulation should be done with caution. For example, using the regional USGS model with 2000-ft grid spacing to supply boundary conditions for smaller scale models is inherently inconsistent and may not be sufficiently accurate. This is particularly true in the area northeast of the bedrock outcrop where there is an absence of good field data and where 2000-ft resolution does not accurately define the geology.

A certain level of calibration adequacy should be required for all of the numerical studies. Calibration has improved dramatically over the years. In the zones above and below the bedrock outcrop where water table gradients are flat, calibration is acceptable. However, in the area near the bedrock outcrop and to the east, more improvement is necessary. The Dames and Moore effort obtained an entirely different level of calibration. It is understandable considering the level of effort and purpose of their study; however, equivalent levels of calibration should be achieved if the results are to be used to make decisions.

The US Army Groundwater Modeling Technical Support Center (Center) should be used to assist in the development of the conceptual and numerical models in the future. This Center is funded by the Army to provide technical support to modelers that will ensure successful completion of model studies. The Center is most effectively used as internal peer review during the modeling process. The Center should be involved in the development of future grids or meshes and the development of representative boundary conditions. Calibration and optimization simulations should only be initiated if there is agreement between modelers on the design of the numerical model grid and application of boundary conditions.

5.4 Recommendation: Staged modification of the extraction system should be considered to evaluate alternate operations designed to improve remedial activities at TEAD.

Discussion:

Reevaluation of the decisions that were made in the early 90's to create the present pump and treat system for the remediation of TCE in the aquifer is long overdue. Both the execution of the present system and the basic goals and objectives of the system need to be reevaluated. To perform this reevaluation, TEAD needs to gather additional data, perform analysis to reset the goals and objectives, and develop reasonable positions to take to the public and regulatory agencies. These activities are required to gather support for this significant change in aquifer cleanup strategy. The recommended future efforts can be divided into five major areas as follows:

- a. Change of Goals and Objectives,
- b. Additional Modeling Efforts,

- c. Additional Source Identification,
- d. Alternative Analysis, and
- e. Changes in the Pumping Scheme.

Change of Goals and Objectives – The present goals and objectives of the pump and treat system are to prevent TCE contamination from migrating off-site and to remediate the entire contaminant plume to below drinking water standards. Operation of the present remedial system and a general knowledge of pump and treat systems suggest that these goals are unattainable. The ITR team suggests that a new goal should be to remediate the aquifer so that TCE contamination equal to or greater than 5 ug/L will not reach the property boundary (i.e. use natural aquifer attenuation to reduce contaminate levels) and to assure that there is no off-site exposure to contaminants above drinking water standards. The drinking water standards should be applied under reasonable usage scenarios at the POE and not necessarily at the property boundary.

Additional Modeling Efforts – Contaminant transport modeling is needed to support and justify changing the goals and objectives of the present pump system. First, a model needs to be developed that can determine the concentration of contaminants in a source area that would lead to an acceptable concentration at the POC (i.e., property boundary). For example, if 100 ug/L of TCE at the source area would lead to less than 5 ug/L TCE at the property boundary within a reasonable planning period (e.g., 30 years) then the goal at the source should be 100 ug/L rather than 5 ug/L TCE. In addition, the model needs to predict plume characteristics if pumping at the boundary were terminated. For example, if the plume is at steady state without pumping, then the pumping system at the boundary can be turned off and extraction accelerated in the sources areas.

Additional Source Identification – Modeling studies should be conducted to provide source area contaminant concentrations that are protective of the site boundary. Additional investigations should evaluate source areas based on concentrations of concern and the likelihood of exceedance in any specific area given available data.

Alternative Analysis - Based on protective contaminate concentrations, alternative technologies for source area control will need to be evaluated. Depending on the target concentrations, the alternative technologies to be evaluated could include soil vapor extraction systems, in-situ chemical oxidation, or enhanced bioremediation. The goal of these alternative technologies would be to reduce the source area contaminants to target concentrations in the most cost-effective manners possible. While alternate technologies are under consideration, pumping in source areas should be continued and optimized until these alternatives can be fully evaluated.

Changes in Pumping Scheme – Based on the above analysis, the present pumping system should be optimized and changed to take into account the new goals and objectives and to minimize the amount of low concentration water that is presently being

pumped. Minimal amounts of groundwater at the boundary and downgradient of the source area should be pumped and more groundwater should be pumped from source areas.

Implementation Options:

The ITR team believes that modeling at TEAD should be consolidated to establish one site model. This effort should begin as soon as possible. Modeling results (i.e., target source area concentrations, optimized pumping configuration, etc.) will be used to begin discussions with the public and regulatory agencies regarding changes in remediation goals and objectives. Upon determination of the new goals by the mutual agreement of the stakeholders, alternative technologies to meet these goals should be evaluated and field tested while maintaining the current pump and treat system in the source area. After this is accomplished, implement useful alternative technologies in place of the present pump and treat system.

5.5 Recommendation: The SVE pilot test should include a component that studies source area contribution (i.e., percentage of contaminant from vadose zone versus groundwater), source area concentration/mass, and source area configuration that will be important in determining the scalability and general utility of this remedial methodology at TEAD.

Discussion:

The ITR team supports the SVE pilot test for the oil/water separator area. It should provide useful information on the effectiveness of vadose zone source removal. It should be kept in mind however, that the pilot test would not necessarily provide information on the effectiveness of SVE in restoring groundwater quality. There are several issues that must be addressed:

- a. Soil in the soil/water separator area is permeable and the SVE influence zone is likely to be extensive in both horizontal and vertical direction. Installation of the SVE well to a depth near groundwater (i.e., 345 feet bgs) may obscure resolution of the uncertainty of vertical influence. Vertical influence is a very important factor. It will determine the optimum depth for the SVE to capture the VOCs in the soil at the minimum cost.
- b. TCE and other chlorinated compounds are easily volatilized and mobilized by the airflow due to SVE pumping. This may contribute significantly to the total SVE analytical results. More attention needs to be paid to this volatilization when evaluating pilot sampling test results (i.e., total quantity and tailing effect of high VOC concentration).
- c. It is very important to have detailed information of VOC concentrations within soil matrix, especially in low permeability zones. The understanding of VOC concentration within the soil matrix will help to determine the total VOCs quantity

within the whole matrix. It will guide the SVE process, especially with regard to the appropriate point of SVE termination.

The proposed SVE pilot test as currently configured will provide information on the technical practicability of recovery of vadose zone chlorinated solvents. However, this uncertainty may or may not be critical to the underlying goal, which is restoration of the groundwater.

Two additional uncertainties should be addressed either prior to or in conjunction with the SVE pilot test. First, the relative contribution of vadose zone and groundwater contaminants to the ongoing groundwater contamination should be estimated. Complete removal of unsaturated zone contaminants will be of little value if the majority of the ongoing source is already within the saturated zone. Second, the scalability of the results obtained in the vicinity of the oil/water separator to the main plume should be quantified. These two uncertainties are discussed separately below.

Vadose Zone/Groundwater Source Contributions – The estimate of the relative contribution of vadose zone should be accurate to the order of magnitude necessary to determine the likely impact of SVE on groundwater restoration times. The importance of vadose zone contaminant to achievement of the ultimate groundwater restoration goal decreases as its contribution to ongoing groundwater contaminant mass decreases. SVE, regardless of its technical practicality, provides increasingly diminishing value as the contribution of vadose zone contaminants to ongoing groundwater impacts decreases.

The importance of vadose zone contaminants and by extension the value of SVE should be addressed initially with a mass balance assessment of the probable distribution of TCE in the vertical soil column. Although the quantity and concentrations of the material released in the vicinity of the oil water separator is not known, a range can be established for these parameters. The field data available for groundwater quality throughout the Northeast Plume and soil vapor in the vicinity of the oil water separator can be used to develop a separate estimate of the mass present within the environment. This analysis can be performed with the field data that is currently available.

If SVE is unlikely to accelerate groundwater improvement by more than the margin of estimation error, the entire field program should be reconsidered. Under this scenario, pilot activities would likely be better focused on options for accelerating the degradation of solvents already within the groundwater. For example, the analysis as described above may indicate that most of the mass of the source contribution is from within the groundwater in the immediate vicinity of the oil water separator. The high groundwater concentrations appear to be confined to a relatively small area. This opens the opportunity for injection of additives such as Phostar, a hydrogen reducing compound (HRC), or even molasses, over a limited area to potentially obtain source mass reduction much more significant than obtainable with SVE.

Scalability of Results – The SVE pilot study is currently planned for the vicinity of the oil water separator. Although not explicitly stated, it appears that an assumption has been made that the results can be extrapolated to the conditions within the plume associated with the IWL and ditches. The sufficient commonality of conditions to allow such extrapolations has not been addressed. The Northeast Plume is associated with a relatively high concentration, low volume release. By contrast the IWL plume is associated with a relatively low concentration, high volume release. This release resulted in the buildup of up to 30 feet of mounding under the ditches, ponds and lagoons. As such there was a significant vertical saturated flow component for many years. The distribution of contaminants between the vadose zone and groundwater could be quite different between the two plumes.

The most practical methodology to test the impact of partitioned material on ongoing groundwater contamination would be pilot surge pumping in the source areas of the IWL plume. Variable pumping schemes could provide empirical evidence regarding the impact of contaminants already within groundwater. If the material within the groundwater is sufficient to sustain unacceptable elevated concentrations for years, SVE is of little value as the first line defense. SVE may have reasonable marginal value after the groundwater itself is aggressively addressed. However, it is likely that SVE will not advance the objective as quickly or effectively as modified pumping or additives as discussed above.

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APPENDIX B: PANEL BIOSKETCHES

Hydrogeologist

Mr. Ira P. May, P.G.

Mr. May is the former chief of the Geology and Chemistry Branch, US Army Environmental Center. He has been with the Center since 1985 and has been involved in over 15 major installation projects during that time in both installation restoration and base closure activities. He served as the Army's representative to the National Research Council's Committee Study on the Use of Groundwater Modeling in Regulatory Agencies and is presently serving on a National Research Council's Committee on Intrinsic Remediation. He was a senior technical advisor to three Army Science Board studies [(1) on groundwater modeling (2) on natural attenuation and (3) on effectiveness of pump and treat systems]. Prior to joining USAEC, he was a geologist with several environmental consulting firms as well as the Clean Water Action Project, a national public interest group. Mr. May studied geology at the Hebrew University of Jerusalem and the Johns Hopkins University and did graduate work at the University of Delaware in trace metal geochemistry.

Modeling

Mr. David Richards

Mr. Richards is a Research Hydraulic Engineer at the U.S. Army Waterways Experiment Station (WES) in Vicksburg, Mississippi, where he has worked for 20 years. Previous to that, Mr. Richards was employed for 4 years at two large engineering consulting firms. He has a B.S. degree from the University of Maryland at College Park and a M.S. degree from the University of Texas at Austin. He is currently the Director of the U.S. Army Groundwater Modeling Technical Support Center at WES. The Center is funded by the AEC and the Corps of Engineers to provide groundwater modeling technical support to field installations and Corps District offices. He has been active in surface water and groundwater modeling systems development and application for over 20 years.

Vadose Zone

Zhenhua Jiang, Ph.D

Mr. Zhenhua Jiang is an Environmental Engineer at the Environmental Assessment Division, Argonne National Lab in Chicago, Illinois, where he worked for 6 years. He has a BS in Civil Engineering from Tongji University, Shanghai, China, 1985 and Ph.D. in Civil and Environmental Engineering from Duke University, Durham, North Carolina, 1992. He has been working and doing research extensively in the field of contaminant

transport modeling for last 10 years. He also has extensive experience in GIS application and information management.

Environmental Regulations

Robert E. Bock, J.D.

Mr. Bock has been working in the environmental law field for the past 8 years at Lockheed Martin Energy Research, Inc. at Oak Ridge National Laboratory, Oak Ridge, Tennessee. Mr. Bock received his Doctor of Jurisprudence from the University of Tennessee College of Law in 1992. Primarily, Mr. Bock has been involved in providing support to the Department of Energy (DOE) and Department of Defense (DOD) sites in the identification and justification of regulatory requirements for the cleanup of these sites pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA).

Human Health and Ecological Risk Assessment

Deborah Barsotti, Ph.D., DABT

Dr. Barsotti has more than 18 years of experience in the analysis, prediction, and prevention of adverse environmental and human health effects from chemical exposures. As a Diplomat of the American Board of Toxicology since 1986, Dr. Barsotti promotes the use of sound science when conducting risk assessments. She has extensive experience dealing with the toxicological and risk assessment issues surrounding a variety of environmentally relevant substances, including respiratory carcinogens (asbestos and silica), dioxins, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), petroleum hydrocarbons, chlorinated solvents, and metals. Dr. Barsotti has extensive experience in risk-based remediation within a variety of State risk-based remediation program including Alabama, Ohio, Pennsylvania, New Jersey, North Carolina, Michigan, Florida, Wisconsin and Illinois.

She has employed risk assessment in a broad spectrum of projects, including land acquisition and sale, voluntary cleanups, CERCLA and RCRA sites, indoor air problems, and litigation support and strategy including toxic tort, product liability, class action and workman's compensation claims. Dr. Barsotti has provided expert witness in county, state, and federal jurisdictions in areas of toxicology, risk assessment, and causation. Dr. Barsotti is responsible for technical consultation and project management of applied toxicology and human and ecological risk assessment projects. She has experience applying risk assessment tools to environmental problems that result in cost-effective strategies. In addition, Dr. Barsotti has considerable experience in communicating complex issues of toxicology and risk assessment to non-scientific audiences including citizens' groups, interacting with the national and international regulatory community, and responding to regulatory and legal issues. Prior to joining HLA, Dr. Barsotti has held positions in academia (Philadelphia College of Pharmacy and Science - Assistant Professor in Toxicology and Coordinator of the Toxicology

Program), government (ATSDR - Division Director of Toxicology) and private industry (Exxon Biomedical Sciences - Group Head Hydrocarbon Solvents). Dr. Barsotti received her B.A. in Biology with a Medical Technology Option from Humboldt State University in Arcata, California and her Ph.D. in Pathology from the University of Wisconsin, Madison.

Decision Analysts

Mr. William Hall, B.C.E

William Hall (B.C.E., Georgia Tech) is NewFields' Chief Executive Officer with over 20 years of experience as a strategic planner for complex issues involving a multitude of technical disciplines. His background includes detailed design as chief engineer for over \$100 million in constructed facilities, management of multi-million construction projects, management of business units with over \$20 million in annual income, and strategic planning for projects with potential expenditures in excess of \$1 billion.

Mr. Hall has been involved throughout his career in resolving business and engineering problems that challenged conventional engineering, public policy, and communication approaches. The following represents the range of issues with which he has dealt: forensic engineering; comprehensive water supply/waste water natural system recycling plan for Sarasota County; containment and recycling of contaminated runoff; contaminant pathway probability analysis. Mr. Hall, prior to becoming CEO of NewFields, was a Partner and Vice-President of Dames & Moore Group. He was General Manager of Southeastern operation consisting of approximately \$20 million in annual fees and 130 employees. He also developed and served as General Manager of the firm-wide Total Cost Control initiative aimed at strategic management of hazardous waste liabilities.

Landfill Technology

Edward W. Hoylman, R.G., C.HG.

Mr. Hoylman is a founding Principal of Pacific GeoScience. He has 22 years of experience in the areas of water resources and developmental research/implementation of vadose and groundwater monitoring systems at hazardous and municipal waste landfills, impoundments, land treatment facilities, energy resource development sites, and petroleum refineries. Mr. Hoylman co-authored a book entitled *Vadose Zone Monitoring at Hazardous Waste Sites*. This publication is referenced under the California Code of Regulations (CCR) as a guidance manual for the design and development of monitoring systems at land disposal facilities. Prior to establishing Pacific GeoScience in 1995, Mr. Hoylman was a Principal at ENVIRON Corporation responsible for a public sector practice which focused on the solid waste industry. As a Principal with ENVIRON, and with prior work experience as Director of the Environmental Services Division at Herzog & Associates, he has conducted Class III

landfill siting studies, prepared Remedial Investigations/Feasibility Studies, Delineation Assessment Reports, Evaluation Monitoring Programs, Engineering Feasibility Studies for Corrective Action, Report of Waste Discharge, and technical responses for Cease and Desist Orders issued by California Regional Water Quality Control Boards in accordance with Title 27 CCR and Federal Subtitle D regulations. He has authored Report of Disposal Site Information, Closure, and Postclosure Maintenance Plans at solid waste disposal facilities for the California Integrated Waste Management Board in accordance with Title 27, CCR. Within the last several years, he has worked at numerous Class III, Class II, and Class I waste disposal facilities throughout California and has provided technical litigation support for a multi-million dollar dispute regarding handling and disposal of hazardous waste materials at a Class III landfill. Mr. Hoylman is a registered geologist in the states of California and Oregon, a certified Hydrogeologist in the State of California, and a Professional Hydrogeologist with the American Institute of Hydrology. He holds B.S. Degrees in Geology and Hydrology and a M.S. Degree in Geology from the University of California at Los Angeles.

APPENDIX C: THE INDEPENDENT TECHNICAL REVIEW PROGRAM

The U.S. Army's Environmental Restoration Independent Technical Review (ITR) program was established to provide a mechanism for Army leadership to assess and defend expenditures of environmental restoration funds at Base Realignment and Closure (BRAC) Installations. The program was initially known as Peer Review and was piloted in FY97. During FY98, reviews were conducted at 14 BRAC Installations, and pilot reviews were conducted at two active (non-BRAC) Installations. In FY99, the program was renamed Independent Technical Review, and it is currently being implemented at both BRAC and active Installations.

The primary goals of ITR are to provide an unbiased, independent technical assessment of selected environmental restoration projects, to ensure that an appropriate level of risk reduction is being pursued, and to develop recommendations that highlight potential opportunities to more cost-effectively achieve project goals. Specific objectives of the ITR program also include the following:

- Provide expert technical assistance to the Installation.
- Validate and enhance the credibility of the Installation's environmental restoration program.
- Promote the use of risk-based approaches as remediation decision-making tools, based on properly conducted site-specific risk assessments as necessary.
- Ensure that proposed remedial actions can achieve stated remediation goals.
- Promote risk management approaches to ensure that the costs and benefits of remedial alternatives are properly assessed and balanced.
- Identify opportunities to streamline the remediation process through the use of accelerated removal actions, presumptive remedies, and focused feasibility studies.
- Identify opportunities to apply innovative technologies that are demonstrated to be cost-effective and protective of human health and the environment.
- Establish consistency in the environmental restoration decision-making process across the Army and provide "lessons learned" to the field and headquarters.

In general, the greatest potential benefit of ITR is the expert technical assistance that is made available to the Installation. The review provides a relatively informal forum in which Installations can gain insights from the panel members, who are among the nation's top experts in their respective fields. This is particularly true when opportunities exist to benefit from an emergent technology with which a panel member is familiar. Technical assistance to Installations is not limited to the on-site visit, and may be requested by an Installation subsequent to the ITR meeting. Requests for follow-on

assistance may be made through USAEC's Environmental Restoration Oversight Manager (ROM).

Through the ITR process, it is anticipated that available restoration funds can be used more efficiently to protect human health and the environment, thus decreasing the need to divert funds from Army mission requirements (for example, readiness, training, etc.).

The FY99 ITR Implementation Paper (Attachment C) outlines three different levels of review. The level of review conducted at a particular Installation is selected based upon the number of projects at the Installation, the complexity of those projects, and potential for significant cost savings. The following TEAD sites were selected to undergo a Level 1 ITR review:

- TNT Washout Facility
- North Area Sanitary Landfill
- WL and Ditches
- Industrial Area Groundwater Sources

A Level 1 ITR review generally consists of the following activities:

- Review of background materials. To gain a general familiarity with the Installation and relevant restoration activities, the ITR team reviews background documents provided by the Installation. These documents include an Installation Information Form, which was developed by USAEC, and is completed by the Installation to summarize the status of the restoration projects to be considered in the ITR.
- A visit by the ITR team to the Installation. During this visit, the Installation representative(s) provides an overview of the environmental restoration program and site-specific briefings on the projects undergoing review. A site tour is also included as part of the ITR visit. During site-specific presentations, the Installation's representative(s) presents information on investigative efforts to date, an evaluation and interpretation of available site data, risk assessment findings, remedial technologies considered, plans for future activities, and estimates of funding required to complete planned restoration activities. Interactive discussions between the ITR team and Installation representatives occur throughout the presentations.
- Identification of issues that highlight areas where project execution may be enhanced or cost efficiency may be gained. Significant issues are identified by the ITR team based on discussions during the site visit, which can be either overarching (that is, applicable to more than one project) or project-specific. Recommendations are then developed to suggest specific actions that may be taken to improve or enhance ongoing restoration activities at the Installation. Each recommendation is supported by the ITR team's rationale for making the recommendation and suggestions for implementation.

- Preparation of the ITR Recommendations Report. A draft ITR Recommendations Report is prepared by the ITR team and provided to the Installation, generally within six weeks of the ITR visit. The draft report is intended to provide the Installation with an opportunity to:
 1. Review the report for accuracy and to ensure that the recommendations are adequately explained; and
 2. Prepare a written response that either outlines plans for implementing the ITR team's recommendations, or provides the rationale for modifying or rejecting the recommendations.

Upon receipt of the Installation's responses, the ITR team reviews the Installation's submission for clarity and completeness. A final ITR Recommendations Report is then prepared and disseminated to the Installation and their Major Army Command (MACOM).

May 11, 2001

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APPENDIX D: FY00 ACTIVE SITES, INDEPENDENT TECHNICAL REVIEW, IMPLEMENTATION PAPER

1 Jun 99

1.0. INTRODUCTION

1.1. Independent Technical Review (ITR) is a mechanism through which Army installations obtain independent technical expertise to facilitate the project decision-making process. This process was previously known as Peer Review. However, numerous comments indicated that another name would more accurately capture the nature of the reviews. The intent of this independent input is to ensure (a) an appropriate level of risk reduction at a site, and (b) the efficient use of the Army's Environmental Restoration Funds.

1.2. The focus of Independent Technical Review in FY00 is on both Base Realignment and Closure (BRAC) and active site restoration projects. However, this implementation paper specifically addresses the active sites program. In the future, Independent Technical Review may be expanded to include other Department of the Army Environmental Programs (e.g., Formerly Used Defense Sites (FUDS), Pollution Prevention, Conservation).

2.0. PURPOSE

The purpose of the Restoration Independent Technical Review is:

- 2.1. To validate and enhance the credibility of the Army's environmental restoration decisions.
- 2.2. To validate the rationale used to scope and select remedial actions.
- 2.3. To ensure the use of a risk-based approach as a remediation decision tool, as well as the incorporation of a properly conducted, site-specific, risk assessment.
- 2.4. To promote a risk management approach to provide cost-benefit balance.
- 2.5. To evaluate the technical ability of the proposed remedial action to achieve stated remediation goals.
- 2.6. To identify opportunities to use accelerated removal actions, presumptive remedies, and innovative technologies.
- 2.7. To ensure that cost-effective approaches are employed in order to conserve Army environmental funds.

- 2.8. To promote consistency of restoration decisions across the Army.
- 2.9. To provide "lessons learned" to the field and to Army headquarters.

3.0. RECOMMENDED ARMY INDEPENDENT TECHNICAL REVIEW APPROACH

3.1. The Army Environmental Restoration Oversight Program is currently managed at the U.S. Army Environmental Center (USAEC). This continuous oversight program provides budgetary management and technical assistance to the Installation Restoration (IR) environmental programs.

3.2. Independent Technical Review has been developed to enhance the Army's Restoration Oversight Program. It provides input to the current restoration technical and funding decision-makers (i.e., installation, Major Subordinate Commands (MSCs), Major Commands (MACOMs), and Army Headquarters). The greatest benefit is obtained by making expert technical assistance available at the field level for formulating or improving upon restoration solutions. The panel's expert technical opinions can also be useful to the installation when negotiating with regulators and/or communicating decisions with Restoration Advisory Boards.

3.3. The Army Independent Technical Review Process consists of three phases: Phase 1 - Project Selection; Phase 2 - Independent Technical Review and Recommendation Report Preparation; and Phase 3 - Independent Technical Review Recommendation Implementation.

4.0. PHASE 1 - PROJECT SELECTION/INFORMATION REQUIREMENTS

4.1. PROJECT SELECTION

4.1.1. Since there are limited resources that may be used for Independent Technical Review, only selected restoration projects undergo review. It is important to focus on those projects with the greatest potential return on investment, both in terms of potential cost savings and in terms of the probability that technical recommendations will be implemented. The listed project selection criteria are recommended to serve as general guidelines and not "hard and fast" requirements. Project selection will require input from the installations and MACOMs to ensure selected projects offer a high potential for success. It is not the intent of ITR to expend resources on developing technical recommendations for projects where political or other non-technical factors are clearly driving the decisions. The following criteria are used to consider a site for Independent Technical Review:

4.1.1.1. Site Type: The site must be located on an active installation where ER, A funds are being utilized.

4.1.1.2. Project Phase: Projects through FY+2, from strategic planning to the optimization of O&M, are subject to Independent Technical Review.

4.1.1.3. Funding Requirement: Active sites with a life cycle cost in excess of \$6M may be subject to Independent Technical Review, based on the HQDA decision document approval threshold of \$6M. In addition, MACOMs may elect to have projects below this threshold reviewed, either in conjunction with a planned review or, if no \$6M projects are planned, as a separate review.

4.1.1.4. If the project does not meet the funding requirement criteria, it can still be nominated by Army headquarters, the MACOM, the MSC, the installation, the executing activity, or the USAEC restoration oversight manager if they believe that a project could benefit from an independent technical evaluation. Note that the funding requirement simply identifies projects.

4.2. INFORMATION REQUIREMENTS

4.2.1. Once sites at an installation have been selected for Independent Technical Review, the installation is asked to submit information that the Independent Technical Review team can use to gain a basic understanding of the sites prior to the meeting. The installation is typically requested to provide this information within one month of receiving the request. The information that is requested for each site includes completed site summary questionnaires as well as figures, maps, and tables extracted from pertinent documents associated with the project. To minimize installation efforts, the installation should utilize the executing activity and the USAEC restoration oversight manager to collect the necessary information. The installation is responsible for submitting the information to the USAEC Independent Technical Review Coordinator, and their MACOM/MSC.

4.2.2. Information requirements consist of the following:

4.2.2.1. Site summary:

- history of site
- status of work (completed to date and planned)
- funding, including dollars spent to date and funds planned
- summary of decision drivers, e.g., screening criteria, ARARs, PRGs, regulatory guidance and policies, land re-use
- summary of risk assessment information; e.g., exposure pathways, land use, receptors, COCs, concentrations, calculated risk numbers
- description of alternatives analysis performed and proposed remedial actions.

4.2.2.2. The Installation Action Plan.

4.2.2.3. Location maps, boring maps with data, well maps with data, potentiometric surface maps, geologic maps, etc.

4.2.2.4. Data tables - data tables include data that is considered to be a driver for additional work, risk, or clean up.

4.2. PRE-MEETING VISIT

At the request of the installation, the Independent Technical Review coordinator will participate in a pre-meeting with the installation. The objectives of the pre-meeting are to: (a) communicate the purpose of Independent Technical Review; (b) communicate the type of information that is needed for the conduct of a successful review; (c) provide additional guidance to the installation in preparation for the upcoming meeting (including additional briefing guidance); and (d) gain a basic understanding of the installation's concerns and issues for each of the sites being reviewed. This meeting will occur prior to the installation's submission of required information (approximately one month prior to the Independent Technical Review meeting).

5.0. PHASE 2 - INDEPENDENT TECHNICAL REVIEW FORUM/PANEL DESCRIPTION

The appropriate review structure will be established based on a two-level approach. This will ensure that the level of Independent Technical Review applied to all installations with projects exceeding the cost threshold is consistent with the number of projects, project complexity, and potential return on investment.

5.1. Level 1 - Level 1 reviews are conducted at the installation whose sites are being reviewed. This would typically be applied to installations undergoing an initial review, or where three or more sites are being examined in a follow-up review. Based on the level-of-review required for such installations, site visits are considered cost-effective and necessary.

5.2. Level 2 - Level 2 reviews are conducted at a central location (e.g., at one of the installations, or at a MACOM or MSC) and will cover multiple installations. Installations involved in Level 2 reviews will typically have no more than two projects to be reviewed. With fewer projects per installation, two or three installations can be reviewed during the course of the Independent Technical Review, thereby maximizing the use of the Independent Technical Review panel.

5.3. In order to be successful, the Independent Technical Review process should also be as "installation-friendly" as possible and should provide technical assistance to the

installation. Using the two-level approach, site visits can be made where a high level of review is needed, while the Level 2 reviews can be conducted at central locations.

6.0. INDEPENDENT TECHNICAL REVIEW PANEL AND TEAM MEMBER COMPOSITION

6.1. The Independent Technical Review panel is selected based on a broad knowledge of all aspects of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) programs, as well as specific expertise in the remedial technologies under consideration. Expertise areas include environmental engineering, geology, hydrogeology, project management, remediation technologies, environmental law, risk assessment, and decision analysis. The panel consists of technical experts identified from consultants, academia, and state and Federal regulatory agencies. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), the U.S. Army Research Laboratory (ARL), and the U.S. Army Corps of Engineers (USACE), including USACE laboratories, are also sources of technical experts.

6.2. In addition to the Independent Technical Review panel, there are a number of people from within the Army who make up the Independent Technical Review team. These people have the responsibility of administering a uniform approach to the Independent Technical Review process.

6.2.1. Independent Technical Review Coordinator: The coordinator oversees the entire Independent Technical Review process, to include: planning, organization, scheduling, and implementation of the Independent Technical Review process; determining appropriate project-specific team composition; ensuring adequacy of the Independent Technical Review information package; and ensuring completion and distribution of the Independent Technical Review recommendations. Independent Technical Review recommendations will be distributed to the installation, the MACOM/MSC, and ODEP. The coordinator will also be responsible for briefing the MACOM/MSC, and/or ODEP on the results of the Independent Technical Review, when requested.

6.2.2. Independent Technical Review Facilitator: The Independent Technical Review coordinator will select another individual to serve as facilitator. As moderator, the Independent Technical Review facilitator will ensure an "on task" and "on time" schedule. The facilitator will direct the Independent Technical Review discussion and will not allow it to be "derailed" by other subjects.

6.2.3. Independent Technical Review Panel Members: The Independent Technical Review Coordinator will identify panel members from the disciplines of engineering, environmental law, geology, hydrogeology, remediation technology, risk assessment, and decision analysis. Panel members will not be allowed to serve on the review panels for projects with which they are directly associated to ensure unbiased

recommendations. Specific technical expertise that may be needed to address specific issues at a given installation include:

6.2.3.1. Groundwater Modeling.

6.2.3.2. Unexploded Ordnance.

6.2.3.3. Innovative Technology.

6.2.3.4. Radiology.

6.2.4. The USAEC Restoration Oversight Managers: In addition to the USAEC Independent Technical Review implementation team, USAEC Restoration Oversight Managers (ROMs) play a central role in the Independent Technical Review process at installations for which they perform oversight. The ROMs are responsible for gathering up-front information about their installations. This information will be relayed to the Independent Technical Review Coordinator for distribution to the panel prior to the review meeting in order to establish baseline knowledge of a given restoration program. Because many ROMs have been working with their oversight installations for years, they may already have much of the needed information at their disposal. By submitting such information themselves, the ROMs can save a great deal of time and effort for many involved in the process. The ROMs will attend and participate in the review meetings.

6.2.4.1. Because time is such a limiting factor in the success of an Independent Technical Review, the ROM is a critical resource who must be utilized to the fullest extent of their capability throughout the process. The ROMs shall assist the installation in the preparation of written responses to the draft recommendation report (see section 9.3). The ROM will also be vital in ensuring that Army-accepted recommendations are properly implemented (see section 10.3).

7.0. REGULATOR INVOLVEMENT

7.1. The State and Federal Environmental Regulatory EPA representatives play an integral role in the success of Independent Technical Review. Dialogue with the regulators is critical during the review. Through this communication, regulators can articulate their position on specific issues and gain insight into the perspective brought forth by the Independent Technical Review team members. Regulatory participation also avoids the perception of Independent Technical Review as a biased process designed to promote Army positions at the expense of the environment. Regulatory participation is highly recommended. The installation is responsible for gaining regulator participation.

8.0. PHASE 3 - INDEPENDENT TECHNICAL REVIEW TEAM RECOMMENDATIONS/ RESULTS

8.1. The Independent Technical Review meetings are performed year-round as an integral part of the restoration oversight effort and as needed in support of the upcoming funding cycle. The Independent Technical Review team is not a decision-making body and will only provide advice and recommendations to the existing decision-makers (i.e., installation, MSCs, MACOMs, and Army Headquarters). The existing decision-makers will continue to decide whether a site warrants funding or whether recommendations should be implemented.

8.2. The Independent Technical Review panel focuses on the technical merit of the project at hand. Although technical merit is the primary goal of the review, it is recognized that other factors may have a significant role in the decision-making process. For example, interpretation of regulations, State requirements or guidance policies, etc., generally have a substantial impact on site decisions. The Independent Technical Review process considers the effect that other factors are having on restoration decisions. Technical issues are specified in the Independent Technical Review recommendation report along with a discussion about other factors that are controlling the decision-making process, and the impact that these factors are having on risk management and cost-benefit balance.

8.3. The recommendations of the Independent Technical Review panel are consistent with written Army policy, where available. If formal Army policy does not exist, the Independent Technical Review team will make recommendations based on Army policy as best understood by the Independent Technical Review team. If conflicts arise between the Independent Technical Review panel and the managers of the projects undergoing review regarding the nature or interpretation of Army policy, the Independent Technical Review coordinator shall ensure that the report clarifies these issues.

9.0. INDEPENDENT TECHNICAL REVIEW RECOMMENDATIONS REPORT

9.1. The Independent Technical Review team provides the draft recommendation report to the installation within 40 business days of the review. The draft report identifies areas that the team believes could benefit from an alternative approach. For each site evaluated, the group will identify site-specific issues and over-arching issues (those that impact multiple sites). Recommendations are developed to address each issue. The Independent Technical Review recommendations include the review team's rationale for the recommendation, the assumptions upon which the recommendation is based, and options that the installation may follow to implement the recommendation.

9.2. After the installation has received the draft recommendations report, a follow-up meeting may be held at the request of the installation or the Independent Technical Review coordinator. Attendees may consist of the Independent Technical Review

coordinator, no more than two members of the Independent Technical Review panel, MACOM/MSC representatives, and installation team representatives as deemed appropriate by the installation environmental coordinator. Installation team representatives may include the installation environmental coordinator, the installation project manager, representatives from the executing organization, and contract personnel. The objectives of the follow-up meeting are to: (a) discuss the recommendations outlined in the Independent Technical Review Draft Report in the context of an overall risk-based approach; (b) assure there is a common interpretation and understanding of the recommendations provided in the draft report; (c) discuss the feasibility and optimum manner of implementing the recommendations, and (d) provide additional guidance to the installation in the preparation of written responses to the draft report. The follow-up meeting will occur prior to the installation's submission of written responses to the draft recommendations report.

9.3. The installation is asked to prepare written responses to the draft report, detailing the installation's perspective on the best way to implement the recommendations, if feasible. The response should include a detailed plan outlining the necessary steps to implement the recommendation, an associated timeline for these steps to occur, underlying assumptions, and the revised estimated cost-to-complete of the project using the recommended approach. The cost estimate should be made using the same tool utilized to generate the budget requirement estimate (e.g., RACER, Cost-to Complete module, feasibility study, remedial design estimate). If the installation feels that a recommendation cannot be implemented, the response should discuss the rationale for this assessment in detail. The installation responses will form an appendix to the Independent Technical Review final report. The final report will be sent to the installation, the MACOM/MSC, and Army headquarters. If the installation's responses indicate that the recommendation was not addressed or was misunderstood, the Independent Technical Review panel may be asked to provide additional written comments. While these additional comments will not be incorporated into the final report, they will be useful in the preparation of the summary sheets (see section 10.1). A conference call can be conducted at any time between the installation, the Independent Technical Review coordinator, and members of the Independent Technical Review panel to discuss any issues that are not clear.

10.0. IMPLEMENTATION

10.1. Following receipt of the installation's responses to the draft recommendations report and during finalization of the report, the USAEC Environmental Restoration Division, Program Review and Analysis Branch Chief will prepare draft summary sheets for the site-specific recommendations. The draft summary sheets will include project funding, the Independent Technical Review recommendations in an abbreviated form, the responses from the installation in an abbreviated form, and the advantages/disadvantages of implementing the recommendations. The draft summary sheets will be distributed to the installation, the MACOM/MSC, and Army headquarters in preparation for a conference call. The conference call is the mechanism through which

direct communication can occur and the decision-maker can decide on the appropriateness of implementing the recommendations. Following the conference call, a conclusion section is added to the summary sheets outlining decisions made regarding recommendation implementation. The final summary sheets will be sent to all conference call participants as a record of decisions resulting from Independent Technical Review.

10.2. After the decision-maker determines the appropriateness of implementing the recommendations, the Independent Technical Review panel can be made available to assist the installation in implementation planning. If the installation desires assistance, the installation should contact the USAEC ROM who will in turn communicate the specific installation assistance need(s) with the review coordinator. The USAEC will make available a centrally funded contract mechanism that may be used to provide implementation-planning assistance.

10.3. The installation, with assistance from the restoration oversight manager, will annually prepare and provide a brief report in the Installation Action Plan outlining the progress-to-date on implementing all Independent Technical Review recommendations that the decision-makers agreed would be implemented. The report should also include any additional planning or technical assistance needed from the Independent Technical Review to implement the recommendations.

11.0. EXIT STRATEGY

11.1. Independent Technical Review is not intended to be a long-term program. Independent Technical Review will focus on early identification of opportunities for cost savings and avoidance's by looking at the entire life cycle of the projects to be reviewed. Based on a review of the FY98 constrained cost-to-complete for the ER,A program, Independent Technical Review efforts are anticipated to draw down over approximately five years. The review identified FY00 and FY01 as the peak years for review based on the number of installations that have projects that will meet the selection criteria. The number of qualifying installations drop off significantly in FY02 through FY04; however, there will likely be a need for follow-up reviews and, based on historical performance, a portion of the FY00 and FY01 projects are likely to experience delays which will allow review in later years.

11.2. One of the key purposes of Independent Technical Review is to instill a more sound decision-making approach into the Army's cleanup program. Although Independent Technical Review will be a short-lived effort, the planning and decision-making approaches prescribed by the Independent Technical Review, and lessons learned stemming from Independent Technical Review are expected to be implemented beyond the specific projects and installations that come under review. As these approaches are implemented, the need for Independent Technical Review will lessen. This measure of success for the Independent Technical Review effort will also be used as a key exit criterion. As future Independent Technical Reviews are conducted, the

Army will be able to measure Independent Technical Review success at instilling these approaches by observing the reduction in the number of recommendations for project changes. This, in turn, will signal the declining need for an active Independent Technical Review program. Implementation of sound planning and decision-making practices, independent of Independent Technical Review, is especially critical for long-term remedial actions where continual review of performance and establishment of exit criteria are crucial to minimizing long-term costs.

11.3. Although not always easily put in terms of hard dollar savings, a key measure of merit for Independent Technical Review is return on investment. Where hard cost savings are identified, in terms of adjustments to work plans, return on investment is quantifiable. However, because Independent Technical Review recommendations primarily impact long-range decisions, long-term cost avoidance is the primary result of Independent Technical Review rather than short-term cost savings. Cost avoidance is not easily quantified because of the uncertainty associated with cost estimates in the out years. Also, often the recommendations made by the Independent Technical Review focus on better approaches to planning and decision-making that avoid the need for unanticipated investigations to fill data gaps. Measuring cost avoidance under these circumstances is not possible because planning estimates for the unanticipated efforts are not available, but there is an avoidance nonetheless. Soft savings such as these are still a benefit to the Army's cleanup program and as such will be documented. Part of the exit strategy for Independent Technical Review is to document both the hard savings through return on investment analysis and cost avoidance and soft savings through qualitative discussion. By tracking these measures of success, trends should be identified which should correlate to the continuing need for Independent Technical Review. As discussed in Section 11.2, as sound practices are instilled into the program the need for Independent Technical Review is expected to decline.

12.0. CONCLUSION

12.1. The Independent Technical Review is a mechanism through which Army installations can obtain independent technical recommendations to ensure: (a) an appropriate level of risk reduction at a site; and (b) the efficient use of the Army's environmental restoration funds. This independent input will facilitate the project decision-making process.

12.2. In addition to the direct impact of Independent Technical Review on the specific projects and installations that undergo review, a broader impact is expected across the restoration program through the sharing of lessons learned and incorporation of sound planning decision-making practices espoused by the Independent Technical Review.

12.3. The FY00 focus of Independent Technical Review is BRAC and active restoration projects. In the future, Independent Technical Reviews may be conducted in other Department of the Army environmental programs (e.g., Formerly Used Defense Sites (FUDS), Compliance, Pollution Prevention, and Conservation).

May 11, 2001

APPENDIX E: TEAD RESPONSE TO ITR DRAFT FINAL RECOMMENDATIONS REPORT



REPLY TO
ATTENTION OF

SMATE-CO-EO

DEPARTMENT OF THE ARMY

TOOELE ARMY DEPOT
TOOELE, UTAH 84074-5000

March 27, 2001

MEMORANDUM FOR Commander, U.S. Army Environmental Center, Attn: SFIM-AEC-ERA,
(Jeffrey Armstrong), 5179 Hoadley Road, Aberdeen Proving Grounds,
Edgewood Area, Edgewood, MD 21010-5401

SUBJECT: Response to Independent Technical Review (ITR) Draft Final Recommendations Report of
Environmental Restoration Sites at Tooele Army Depot (TEAD)

1. Reference Tooele Army Depot, ITR, Draft Final Recommendations Report, dated December 2000.
2. Tooele Army Depot has reviewed the subject report and has provided responses to the recommendations in enclosure 1.
3. The primary focus of the ITR report is to prepare a response/strategic plan which addresses groundwater issues associated with the Industrial Waste Lagoon and Ditches; the Northeast Boundary TCE Plume, the Sanitary Landfill, and other potential industrial area sources. As you know Tooele Army Depot has tasked the Sacramento District, Corps of Engineers with the development of such a plan with your assistance. It is anticipated that this plan will be available in early June.
4. Recommendations concerning the TNT Washout Facility and Sanitary Landfill are also being implemented. Tooele Army Depot has initiated a "No Cost" contract modification to conduct additional sampling in the TNT Washout Ponds to further define the required volume of soil requiring excavation. Upon completion of this effort, corrective action alternatives will be re-evaluated in the Corrective Measures Study. Corrective measure alternatives will also be re-evaluated for the Sanitary Landfill.
5. Tooele Army Depot is currently revising the Cost to Complete for both active and BRAC sites on the installation. The implementation of the recommendations and expected out-come will be considered in developing the revised costs.
6. If you should have any questions, or require additional information, please feel free to contact Larry McFarland of the Tooele Army Depot Environmental Office at (435) 833-3235.

A handwritten signature in black ink, reading "Thomas A. Turner", is located above the typed name.

Encl

Thomas A. Turner
Chief, Environmental Office

**RESPONSE TO ITR DRAFT FINAL REPORT
RECOMMENDATIONS**

SECTION 2.0, GENERAL RECOMMENDATIONS

- 2.1 Recommendation: A site-wide strategic plan with a conceptual model should be prepared for TEAD to coordinate remedial operations, promote proactive rather than reactive activities, and allow for prioritization of the clean-up effort.

Response: Tooele Army Depot has tasked the Army Corps of Engineers with developing a strategic plan to address groundwater issues at the installation. The strategic plan will focus primarily on groundwater issues as they relate to the Industrial Waste Lagoon and associated Collection Ditches, Sanitary Landfill, Northeast Boundary TCE Plume, and the Industrial Area Groundwater Sources. The plan is being developed with the assistance of the Army Environmental Center. Elements of the plan will include (1) A groundwater management goal, (2) Identification of uncertainties, (3) A decision analysis identifying criteria for evaluating each uncertainty, (4) Performance standards establishing how success is measured, (5) An implementation plan, and (6) A cost model.

Funding for the completion of the strategic plan has been provided to the Army Corps of Engineers. The effort is being joint funded through BRAC and ERA. A draft strategic plan is due in early June 2001.

- 2.2 Recommendation: Compile site information into a single electronic database that would be available to and enhanced by all contractors that work at the facility. The modeling studies at TEAD should be consolidated into one activity.

Response: Tooele Army Depot has requested that the Army Corps of Engineers, Sacramento District consolidate all sampling and analysis data into a single database. The Corps of Engineers has established a contract with a consultant for compiling the data. The data will be compiled in such a manner that it is accessible to users through the Internet. The web site will also include some limited GIS capability. It should be noted that this effort had been initiated prior to the ITR, but had not been completed.

- 2.3 Recommendation: Identification of the difference between risk-based or legal drivers versus judgement and preference should be established for each SWMU. Actions pursued at a SWMU should be based on a risk-based or legal driver.

Response: All Solid Waste Management Units at Tooele Army Depot are being evaluated through risk based closure. Sites are being addressed under Utah Administrative Code (UAC) 315-101.

- 2.4 Recommendation: Site-specific risk-based assessments should fully utilize current guidance and statistical data evaluation in the decision making process.

Response: Human health risk assessments at Tooele Army Depot have been and will continue to be conducted in accordance with the process recommended by the U.S. Environmental Protection Agency (EPA) guidance in "Risk Assessment Guidance for Superfund(RAGS): Human Health Evaluation Manual, Part A" (EPA, 1989a). The methods used to characterize risk are consistent with the requirements of the State of Utah, EPA Headquarters, and EPA Region VIII, as specified in the following documents:

- ❑ *Utah Hazardous Waste Management Rules, (UAC R315-2 to R315-9, R315-12 to R315-14, R315-50, and R315-101.*
- ❑ *Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual, Part A..*
- ❑ *Exposure Factors Handbook.*
- ❑ *Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors.*
- ❑ *Dermal Exposure Assessment: Principles and Applications*
- ❑ *EPA Region VIII Superfund Technical Guidance*
- ❑ *EPA Region VIII Guidance on Assessing Exposure to Lead*

- 2.5 Recommendation: Army policy requires that evaluation of no action (NA) and monitoring natural attenuation (MNA) is included as remedial action alternatives.

Response: The "No Action" and "Monitored Natural Attenuation" alternatives are included in all evaluations of potential remedies at Tooele Army Depot.

SECTION 3.0, TNT WASHOUT FACILITY

- 3.1 Recommendation: The TNT Washout Facility (SWMU) should be better characterized with existing or new data, if necessary, to recalculate risk and evaluate alternative corrective action alternatives that meet Army policy and eliminate unacceptable pathways.

Response: Tooele Army Depot concurs with the ITR recommendation to conduct additional characterization of the TNT Washout ponds, for the purpose of clearly defining the volume of soil requiring removal and the establishment of performance standards for excavation. On March 21, 2001 Tooele Army Depot requested a contract modification through the U.S. Army Corps of Engineers to have URS Dames and Moore conduct the required sampling.

The requested modification provides for up to 55 samples at three depths, 0-1 feet, 2-3 feet, and 4-5 feet below the existing liner. Field analysis will be conducted on all samples, with 10% of the field samples being submitted as replicates for lab analysis. Samples will be collected in iterative rounds, with the result of each round being used to determine the need to expand the sampling area. No ground water samples will be collected as part of this

investigation. The estimated cost for completing the additional characterization, assuming that all available samples are collected at the three specified intervals is \$92,000.

Upon completion of the additional characterization of the TNT Washout Ponds, corrective measure alternatives evaluated for the site will be revisited prior to recommending a final remedy.

SECTION 4.0, NORTH AREA SANITARY LANDFILL

- 4.1 Recommendation: Future activity at the North Area Sanitary Landfill (SWMU 12/15) should initially focus on 1) repairing the cover to eliminate exposed debris and 2) establishing if the groundwater plume associated with the landfill is stable, expanding, or contracting. Subsequent investigations, assessment, and installation of control measures should be implemented only if necessary to prevent the plume beyond the landfill boundary from expanding.

Response: Based on comments from the Utah Department of Environmental Quality on the Draft CMS Report, as well as comments made by the Independent Technical Review Team, alternatives for closure of the Sanitary Landfill will be re-evaluated, with a focus on monitoring down gradient monitoring wells to develop time series data for evaluation of the landfills impact on groundwater. Additional investigation of the suspected source area in the landfill may be conducted to further evaluate the landfills impact on groundwater by installing a groundwater monitoring well down-gradient and adjacent to the existing soil vapor monitoring well that was previously installed in the suspected source area. The monitoring program, investigation, as well as contaminant transport modeling of the vadose zone will be dependant on the strategic plan that is being developed.

- 4.2 Recommendation: The North Area Sanitary Landfill is classified by UDEQ as a SWMU and should proceed with a risk-based closure.

Response: As the North Area Sanitary Landfill is considered a Solid Waste Management Unit(SWMU), corrective action alternatives will be evaluated in accordance with State of Utah Hazardous Waste Management Rules. Closure of the SWMU will be pursued under Utah Administrative Code (UAC) R315-101. UAC R315-302-3, Closure and Post Closure Requirement for Solid Waste Landfills of the Utah Solid Waste Permitting and Management Rules will not be considered in any future evaluation of corrective measures.

SECTION 5.0, GROUNDWATER REMEDIATION/INVESTIGATIONS AT THE IWL AND DITCHES, AND THE INDUSTRIAL AREA GROUNDWATER SOURCES

- 5.1 Recommendation: TEAD should develop compliance boundaries and establish source area performance standards that maintain MCLs at the property boundary.

Response: Compliance boundaries as suggested by the ITR will be considered during the development of the strategic plan.

- 5.2 Recommendation: TEAD should develop a site-wide monitoring plan that is consistent with and addresses critical uncertainties of the strategic plan.

Response: TEADs groundwater monitoring program will be re-evaluated and modified as required during the development and implementation of the strategic plan.

- 5.3 Recommendation: The Hydrologic Engineering Center (HEC) groundwater model should be utilized to evaluate flow characteristics of the eastside of the bedrock area and study dissipation of the groundwater mound under the IWL.

Response: The requirements for future groundwater modeling efforts will be addressed in the strategic plan, with a focus on consolidating efforts that address the main plume, northeast boundary plume, as well as the landfill.

- 5.4 Recommendation: Staged modification of the extraction system should be considered to evaluate alternate operations designed to improve remedial activities at TEAD.

Response: Modification or elimination of the groundwater treatment system with an emphasis on Monitored Natural Attenuation or other less costly alternatives will be one of the primary goals of the strategic plan.

- 5.5 Recommendation: The SVE pilot test should include a component that studies source area contribution (i.e., percentage of contaminant from vadose zone versus groundwater), source area concentration/mass, and source area configuration that will be important in determining the scalability and general utility of this remedial methodology at TEAD.

Response: The scope of the SVE pilot study has been modified to collect soils data from the vadoze zone and capillary fringe, to be used to better characterize the potential continued impacts to groundwater at the building 679 sump location. Samples were collected during the construction of the vent wells at the site.